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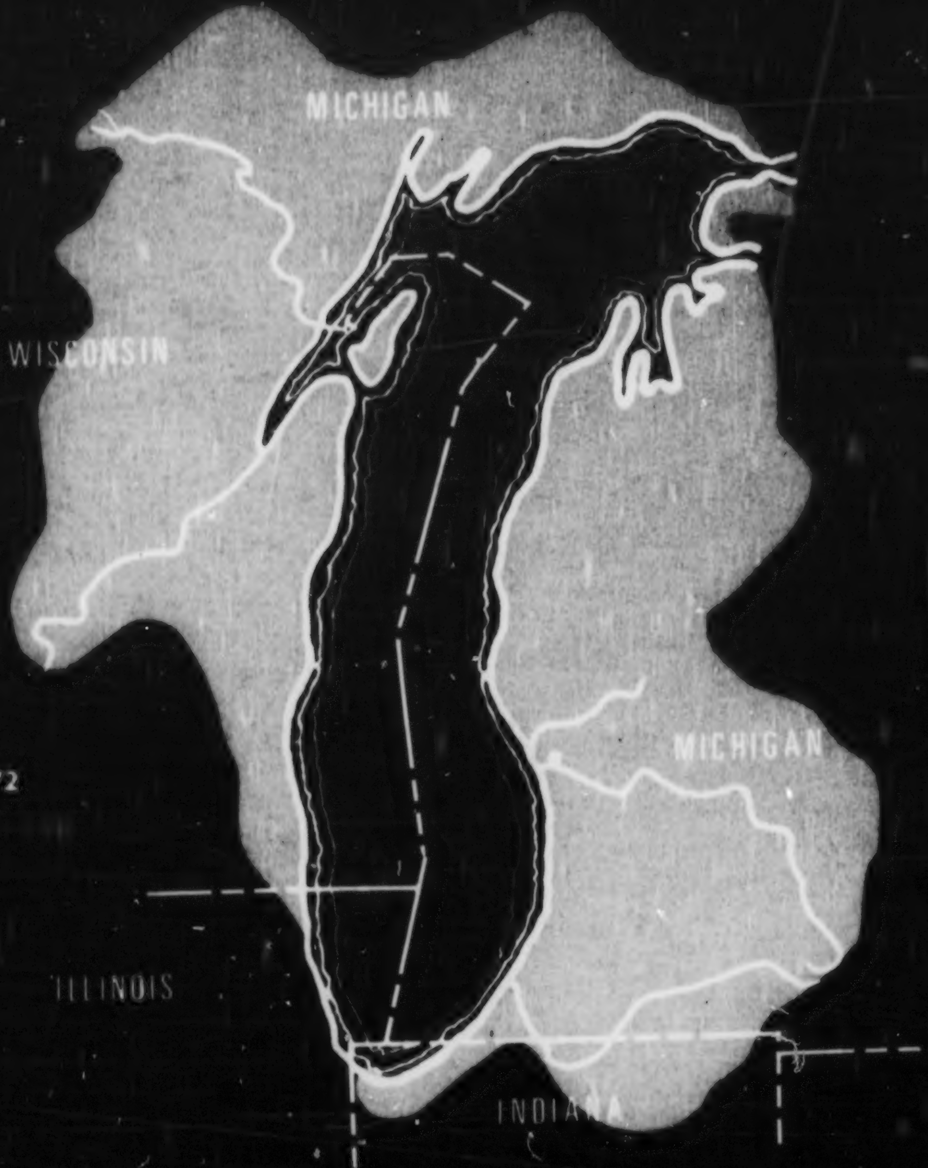
MICHIGAN
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA

Fourth Session
September 19-21, 1972
Chicago, Illinois

CONFERENCE

Pollution of Lake Michigan and its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin

U.S. ENVIRONMENTAL PROTECTION AGENCY

REPRODUCED BY
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FOURTH SESSION OF THE CONFERENCE
IN THE MATTER OF POLLUTION OF LAKE MICHIGAN
AND ITS TRIBUTARY BASIN
IN THE STATES OF
WISCONSIN, ILLINOIS, INDIANA, AND MICHIGAN

VOLUME II

Bal Tabarin Room
Sherman House
Chicago, Illinois
September 20, 1972

Marilyn Hall Associates
COURT AND CONVENTION REPORTING
1372 THURELL ROAD
COLUMBUS, OHIO 43229
614 - 846-3682

286

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→ The conference [illegible] water pollution [illegible]

Fourth Session of the Conference in the Matter of Pollution of Lake Michigan and Its Tributary Basin, in the States of Wisconsin, Illinois, Indiana, and Michigan, held in the Bal Tabarin Room of the Sherman House, Chicago, Illinois, on Tuesday, September 20, 1972, at 9:00 a.m.

- - -

PRESIDING:

Francis T. Mayo, Regional Administrator, U.S. Environmental Protection Agency, Region V, Chicago, Illinois.

- - -

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William L. Blaser, Director, Environmental Protection Agency, State of Illinois, Springfield, Illinois.

Perry E. Miller, Technical Secretary, Stream Pollution Control Board, Indiana State Board of Health, Indianapolis, Indiana.

CONFEREES, Continued:

Ralph W. Purdy, Executive Secretary, Michigan Water Resources Commission, Lansing, Michigan.

James O. McDonald, Director, Enforcement Division, U.S. Environmental Protection Agency, Region V, Chicago, Illinois.

- - -

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David P. Currie, Chairman, Illinois Pollution Control Board, Chicago, Illinois.

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John H. Kitchel, M.D., Commissioner, Michigan Water Resources Commission, Lansing, Michigan.

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- - -

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Arthur H. Cratty, Commissioner, U.S. Department of Agriculture, Great Lakes Basin Commission, East Lansing, Michigan.

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Patricia O'Guin, Committee to Publicize Crisis Biology, Indiana University, Bloomington, Indiana.

Miriam G. Dahl, Wisconsin State Division, Izaak Walton League of America, Milwaukee, Wisconsin.

- - -

WEDNESDAY MORNING SESSION

- - -

MR. MAYO: Ladies and gentlemen, we will continue with the Fourth Session of the Lake Michigan Water Quality Enforcement Conference.

By way of a schedule for today, gentlemen, with the little earlier start this morning perhaps we could break sometime when it is convenient along about 10:30, 10:45 -- sometime between 10:30 and 11:00; continue to 12:45; again, take an hour for lunch; and look forward to terminating the session this afternoon sometime between 4:30 and 5:00 o'clock. And we are very deliberate in our efforts not to run as long as we did last night.

I think we may be in a much more convenient position to break into the program. We need to recognize, however, that we are rather substantially behind the schedule we had set for ourselves yesterday on the agenda, and I would like to make it generally known that should it not be possible to have an adequate discussion and presentation of the thermal information through the 21st, this room has been reserved for the 22nd, and if necessary we can continue on into the 22nd.

MR. MILLER: Do you want comments on that?

MR. MAYO: Excuse me. Yes. Go ahead, Perry.

MR. MILLER: Mr. Chairman, I would say that we in Indiana have a comment or -- pardon me -- a commitment on Friday, and we are going to have to leave here on Thursday evening sometime to get back in Indianapolis for meetings that have been scheduled for Friday morning, so that I don't see how Indiana can have a representation here on Friday.

MR. BLASER: Mr. Chairman, I have a similar problem for the State of Illinois. I can leave a representative here but I would have to be absent on Friday.

MR. MAYO: Well, I think, as has been the practice with the enforcement conference sessions, while there is a desire to move along and handle these things as expeditiously as possible, that where there are major issues before the conference, and there is a need for at least adequate presentation of the positions involved by the parties of interest, that we have made every effort to accommodate that need and to keep the conference in session as long as it might be reasonable to do so under the circumstances. And we just have to be alert to the Indiana and Illinois problems and try to move ahead as expeditiously as we can.

When we recessed last night, prior to the recess, we had the introduction of the Phosphorus Technical Committee report with a summary by Mr. Howard Zar, and we withheld discussion and commentary on the technical committee report

F. Mayo

in order to accommodate Dr. Stoermer, and Dr. Lee, and Mr. Dustin, who were not going to be available today.

So our order of business this morning is to return to the portion of the agenda dealing with phosphorus and its relationship to water quality in Lake Michigan, and to continue with the presentations that had been identified yesterday.

The presentations we have are: Mr. Dan Galloway from Dow Chemical; and a presentation that Mr. Cratty, State Conservationist for SCS in Michigan and a member of the Great Lakes Basin Commission, left to be introduced into the record this morning. Then we have two supplemental reports: one from the State of Michigan, and one from EPA, dealing with the phosphorus issues in Lake Michigan.

I think it would be appropriate, gentlemen, to proceed with those four presentations before getting back to a discussion of the Technical Committee report; and with the four additional statements we ought to have a rather reasonable package of material to which the conferees can address themselves.

So we will move ahead, at this point this morning, with the statement by Mr. Dan Galloway of Dow Chemical Company.

Is Mr. Galloway here?

STATEMENT OF DAN R. GALLOWAY,
ENVIRONMENTAL ENGINEER,
ENVIRONMENTAL CONTROL SYSTEMS GROUP,
DOW CHEMICAL, CHICAGO, ILLINOIS

MR. GALLOWAY: Mr. Chairman, conferees, ladies and gentlemen. My name is Dan Galloway. I am an Environmental Engineer with Dow Chemical's Environmental Control Systems Group in the Chicago office. My testimony on phosphorus removal by chemical means will include four main areas:

1. Phosphorus Removal - "State of the Art"
2. An empirical relationship between metal ion concentration and initial phosphorus concentration.
3. Establishing interim treatment in those areas in which the municipality or industry cannot meet the deadline for phosphorus removal.
4. Estimated capital and operating costs.

The removal of phosphorus from municipal sewage is achieved by the addition of a metal salt followed by a high molecular-weight anionic polyelectrolyte flocculant. Contact between the soluble phosphate anions and multivalent metal cations results in the formation of finelydispersed insoluble particles.

These fine particles normally require agglomeration with a polyelectrolyte flocculant for adequate sedimentation.

... Slide 1 ...

This sequence of processing, which is composed of three steps, gives you an idea of the process. The coagulation step where the metal ion is added under rapid-mixing conditions is followed by the addition of the flocculant and the general delivery of the form floc to the settling tank.

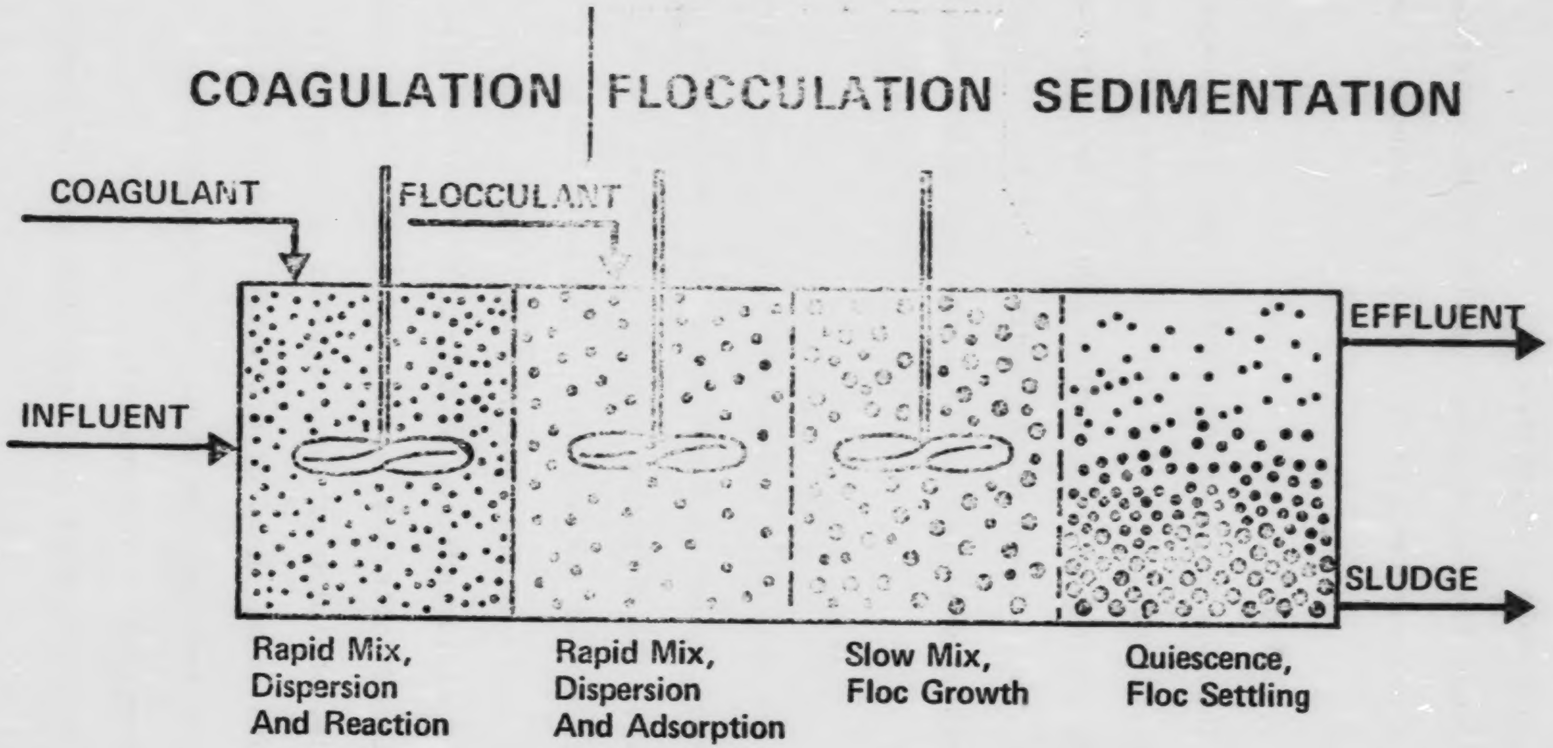
... Slide 2 ...

The metal ion can be introduced prior to primary settling where enhanced suspended solids removal is often experienced. The coagulant can also be added ahead of, or at the tail end of the aeration tanks in activated sludge plants, or added to the feed to trickling filter effluent.

I would indicate on this slide that we have found in a couple of instances split addition of coagulant. In other words, addition of the coagulant had a primary settling and, in this case, ahead of activated sludge, has been effective in reducing the amount of coagulant necessary to meet the particular requirements.

The treatment plant operator must be prepared for

COAGULATION/FLOCCULATION PROCESS SEQUENCE



COAGULATION | FLOCCULATION SEDIMENTATION

COAGULANT

FLOCCULANT

INFLUENT

EFFLUENT

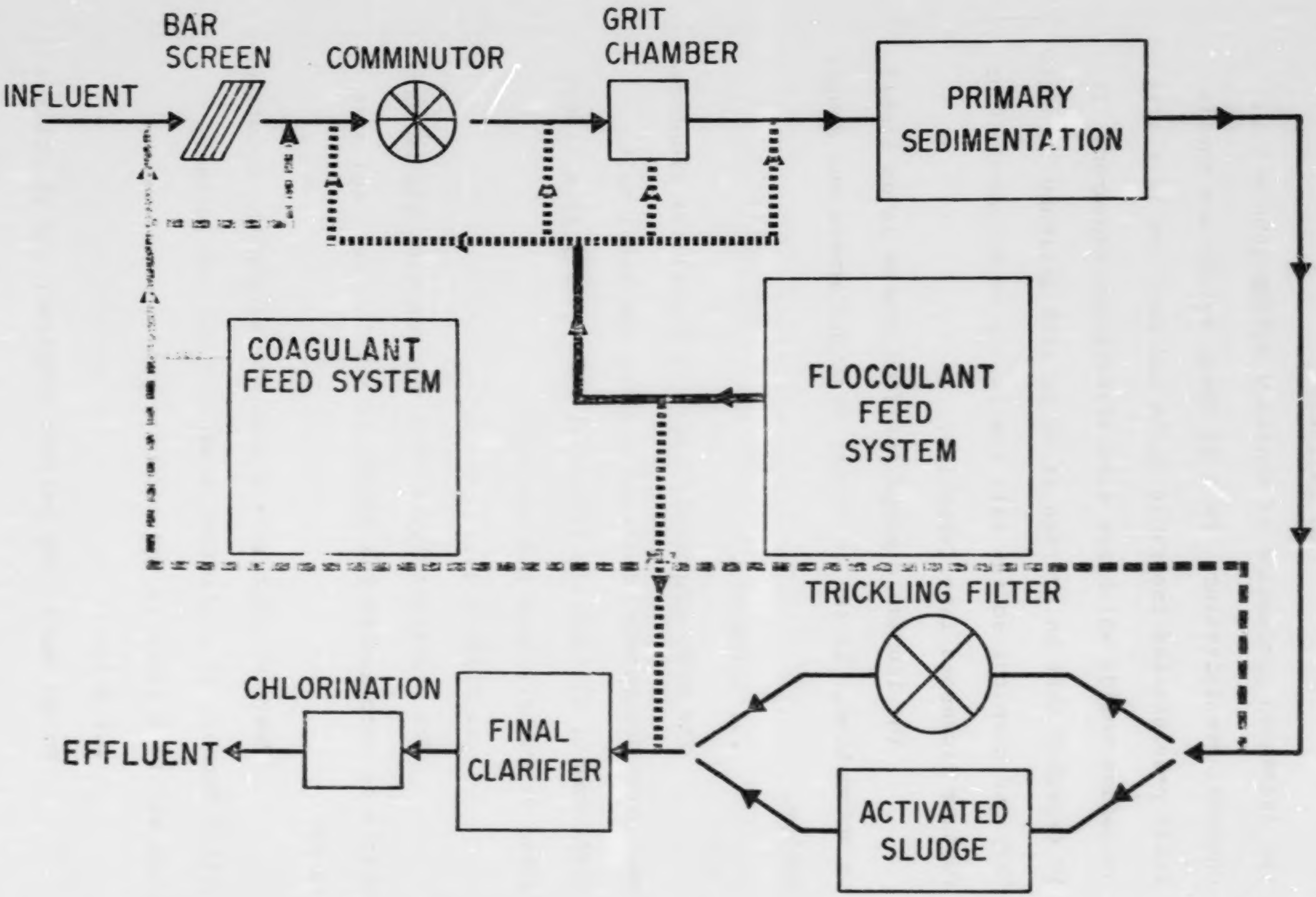
SLUDGE

Rapid Mix,
Dispersion
And Reaction

Rapid Mix,
Dispersion
And Adsorption

Slow Mix,
Floc Growth

Quiescence,
Floc Settling



INFLUENT

BAR SCREEN

COMMINUTOR

GRIT CHAMBER

PRIMARY SEDIMENTATION

COAGULANT FEED SYSTEM

FLOCCULANT FEED SYSTEM

TRICKLING FILTER

ACTIVATED SLUDGE

FINAL CLARIFIER

CHLORINATION

EFFLUENT

FLOW SHEET OF COAGULANT/FLOCCULANT ADDITIONS

D. Galloway

the increased production of sanitary solids inherent in chemical precipitation. Part of these solids are chemically precipitated inorganic salts and part are initially suspended solids which are more effectively captured. It is expected that an average of 20 percent increase in sanitary and chemical solids will result, to be disposed of or further processed into fertilizer.

The inorganic coagulant feed system lends itself to automation. It can be a very straightforward and simple system.

... Slide 3 ...

The main components are: 1) a positive displacement pump adequately protected against the metal salt environment; 2) (plastic flexible) feed lines; 3) a fiberglass or rubber-lined storage tank.

... Slide 4 ...

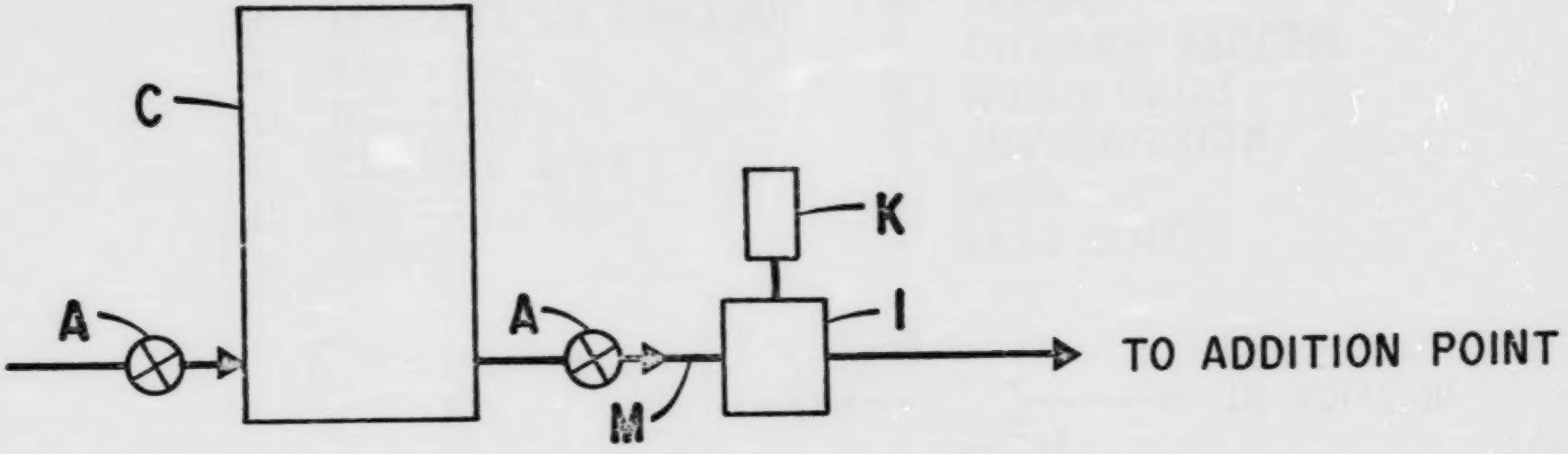
The polyelectrolyte feed systems also can be very simple to accommodate the plants in the 0.1 to 3 mgd size range.

There we just have a tank for mixing the solution, with a funnel, an aspirator, a wetting and dry polymer, pump and feed lines to the addition point.

... Slide 5 ...

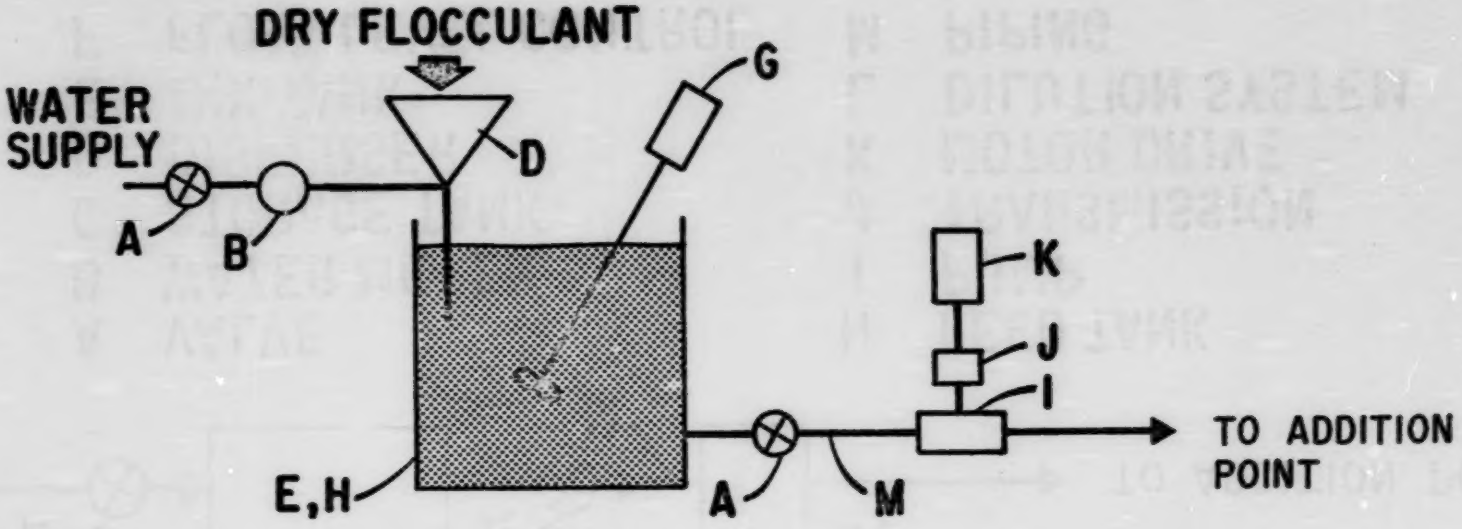
An automatic dry polymer disperser can be utilized

INORGANIC COAGULANT FEED SYSTEM


C
A
A
K
I
M
TO ADDITION POINT

A	VALVE
B	WATER METER
C	STORAGE TANK
D	DISPERSER
E	MIX TANK
F	FLOAT LEVEL CONTROL
G	MIXER
H	FEED TANK
I	PUMP
J	TRANSMISSION
K	MOTOR DRIVE
L	DILUTION SYSTEM
M	PIPING

FLOCCULANT FEED SYSTEM UTILIZING MANUAL DISPERSING EQUIPMENT

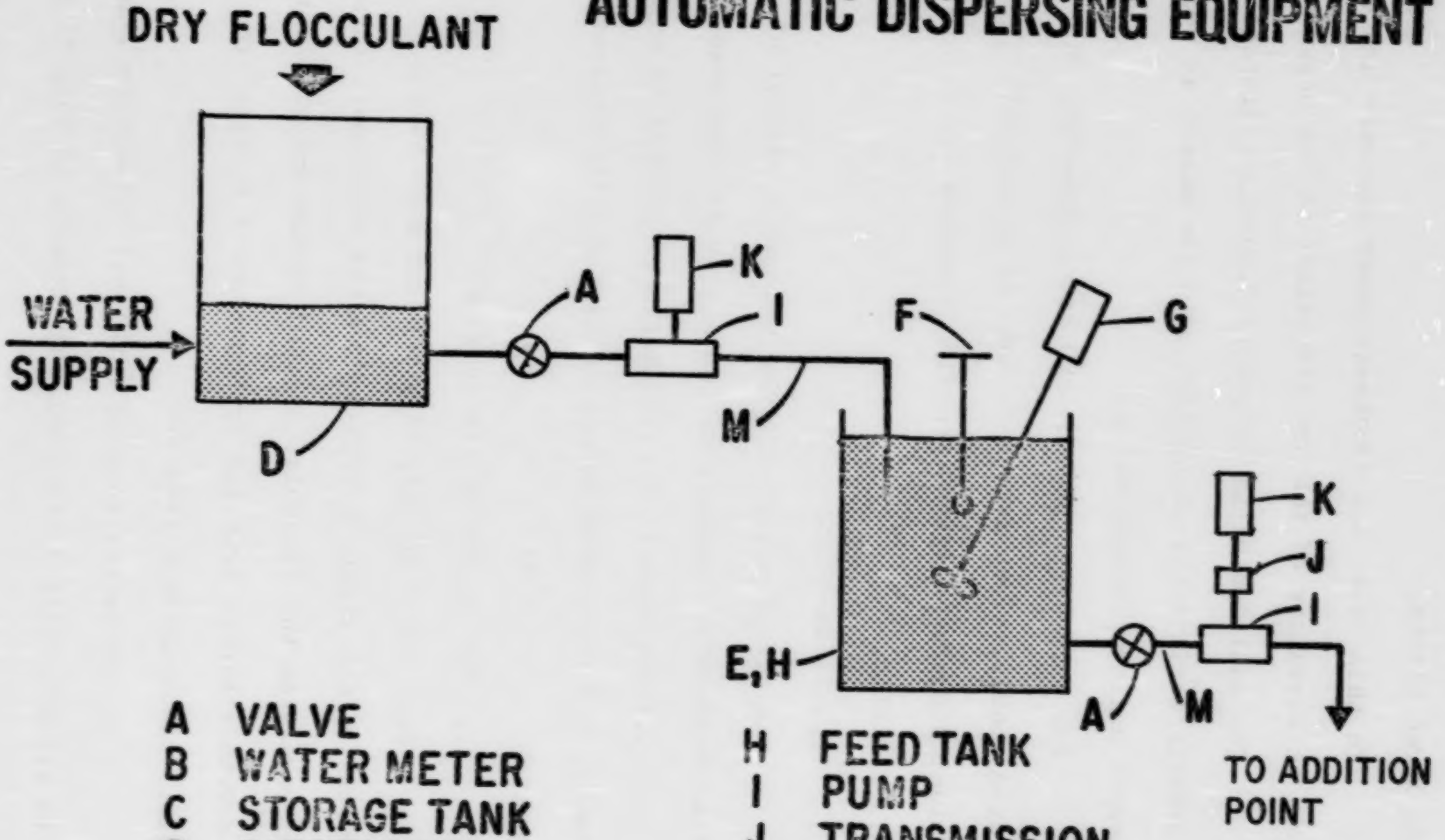

DRY FLOCCULANT
WATER SUPPLY
A
B
D
G
K
J
I
E,H
A
M
TO ADDITION POINT

A	VALVE	H	FEED TANK
B	WATER METER	I	PUMP
C	STORAGE TANK	J	TRANSMISSION
D	DISPERSER	K	MOTOR DRIVE
E	MIX TANK	L	DILUTION SYSTEM
F	FLOAT LEVEL CONTROL	M	PIPING
G	MIXER		

393-e

SLIDE #5

FLOCCULANT FEED SYSTEM UTILIZING AUTOMATIC DISPERSING EQUIPMENT


DRY FLOCCULANT
WATER SUPPLY
D
A
K
I
M
F
G
E,H
K
J
I
A
M
TO ADDITION POINT

A	VALVE
B	WATER METER
C	STORAGE TANK
D	DISPERSER
E	MIX TANK
F	FLOAT LEVEL CONTROL
G	MIXER
H	FEED TANK
I	PUMP
J	TRANSMISSION
K	MOTOR DRIVE
L	DILUTION SYSTEM
M	PIPING

for the large plants.

In this case, the treatment plant operator has to maintain an inventory of the dry flocculant in the hopper.

The addition of an automatic flocculant dispersing unit greatly facilitates flocculant solution makeup as well as assures uniform concentrations.

For very large plants, 100 mgd or greater, an automated chemical feed system as well as an automatic flocculant dispersing system is often required for economic use of chemicals.

... Slide 6 ...

The "loop" system for the automatic control of chemical feed rates operates on two electronic responses:

1. The amount of orthophosphate present in the raw sewage and registered by the automatic orthophosphate analyzer.

2. The volume of sewage flow.

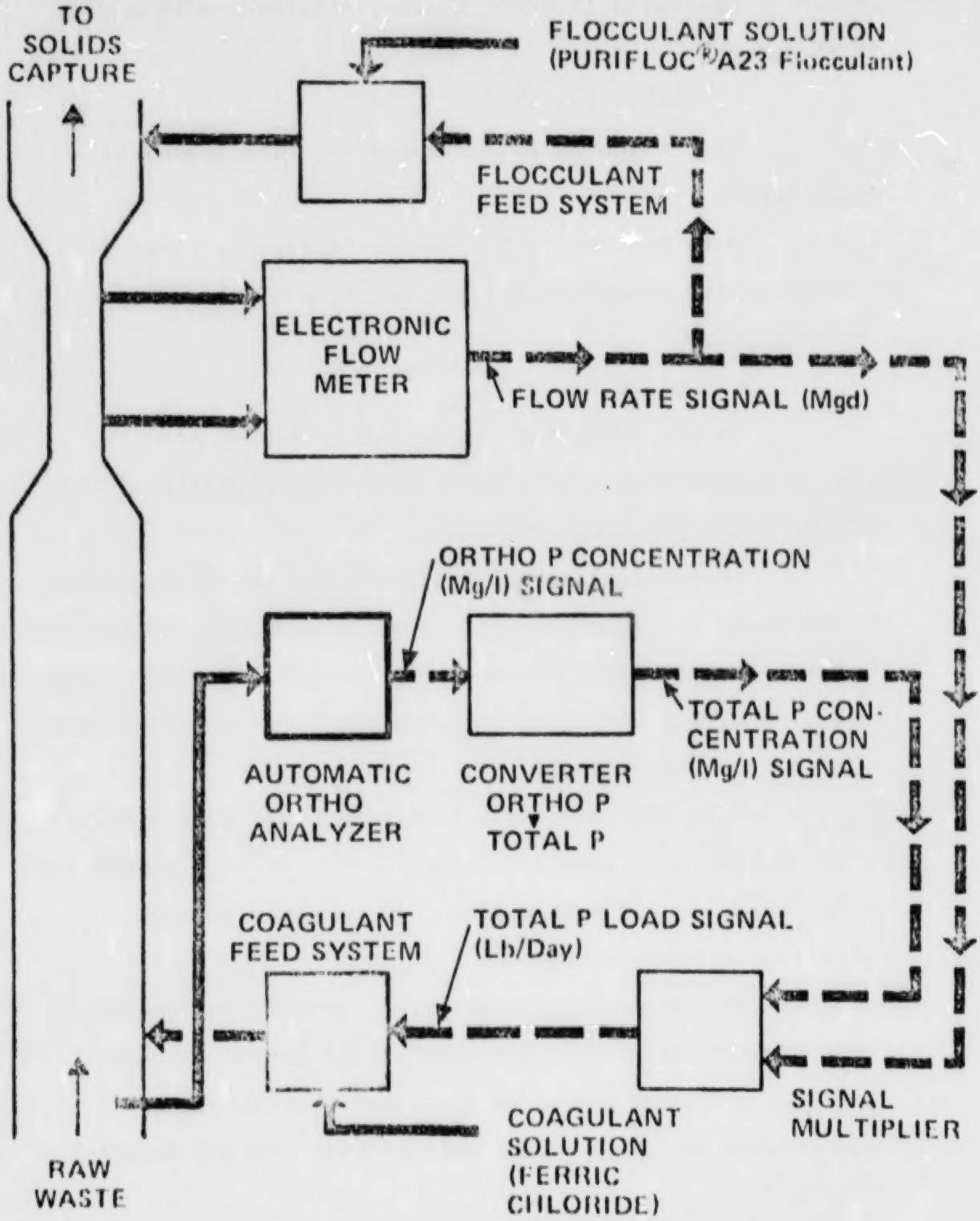
Just for a second, if you would look at our schematic on the right, a signal from the electronic flow meter regulates the flocculation feed system and also combines with a signal from the orthophosphate analyzer to regulate the coagulant feed systems.

The concentrations of metal and polyelectrolytes can be automatically controlled. An example of this "loop"

294-a

SLIDE #6

AUTOMATIC CONTROL LOOP FOR PHOSPHORUS REMOVAL FROM WASTEWATER



TO SOLIDS CAPTURE

FLOCCULANT SOLUTION
(PURIFLOC® A23 Flocculant)

FLOCCULANT FEED SYSTEM

ELECTRONIC FLOW METER

FLOW RATE SIGNAL (Mgd)

ORTHO P CONCENTRATION (Mg/l) SIGNAL

AUTOMATIC ORTHO ANALYZER

CONVERTER ORTHO P ▾ TOTAL P

TOTAL P CONCENTRATION (Mg/l) SIGNAL

COAGULANT FEED SYSTEM

TOTAL P LOAD SIGNAL (Lb/Day)

SIGNAL MULTIPLIER

COAGULANT SOLUTION (FERRIC CHLORIDE)

RAW WASTE

system in operation is Grand Rapids, Michigan, with a flow of 45 mgd.

... Slide 7 ...*

This slide shows the coagulant feed system at Grand Rapids.

Note the two 10,000 gallon fiberglass tanks for storage of the coagulant and the building which encloses the feed equipment.

... Slide 8 ...*

As was indicated, the metallic cation solution feed is automatically proportioned to the intensity of the influent orthophosphate signal.

This signal is multiplied by the specific gravity of the metal ion solution determined by a density transmitter -- which is this piece of equipment here (indicating) on the feed line of the coagulant -- resulting in a mass flow rate.

... Slide 9 ...*

Here the flocculant feed pumps draw from a regulated inventory of chemical solution to provide a particular dosage based on the sewage flow. Flow recorders and totalizers provide a material balance.

As can readily be observed, phosphorus removal technology has advanced over the past 10 years. Enough plant scale trials have been conducted that an empirical relationship has been established between initial phosphorus

*(NOTE: Slide could not be reproduced.)

concentrations and required metal concentrations.

... Slide 10 ...

This relationship has been expressed in a design equation where the final phosphorus concentration over the initial phosphorus concentration is equal to an exponential quantity, a k factor times the metal concentration over the initial phosphorus concentration. ($P_f / P_o = EXP [k_{tp} M/P_o]$)

The significant factor of this equation is the constant k_{tp}. pH and alkalinity present in sewage have relatively minor effects upon k_{tp}. Effects by industrial water, however, may be significant.

Loss in efficiency -- such as mixing, flocculation, sedimentation -- upon scale-up from laboratory to plant-size operation, can also be included in the k_{tp} factor. The particular metal salt used and the concentration of the flocculant also affect the k_{tp}.

The concentration of the metal salt to be added to a particular waste has been established as a linear relationship to the initial but not the final phosphorus concentration.

... Slide 11 ...

In this particular graph, along the right vertical axis, we have the percent removal from 0 to 99.9 percent; along the horizontal axis, the metal to the initial phosphorus

296 A

PHOSPHORUS REMOVAL DESIGN EQUATION

$$P_F/P_O = \mathrm{EXP}\ (\kappa_P M/P_O)$$

P_O = INITIAL CONCENTRATION

P_F = FINAL CONCENTRATION

M = METAL CONCENTRATION

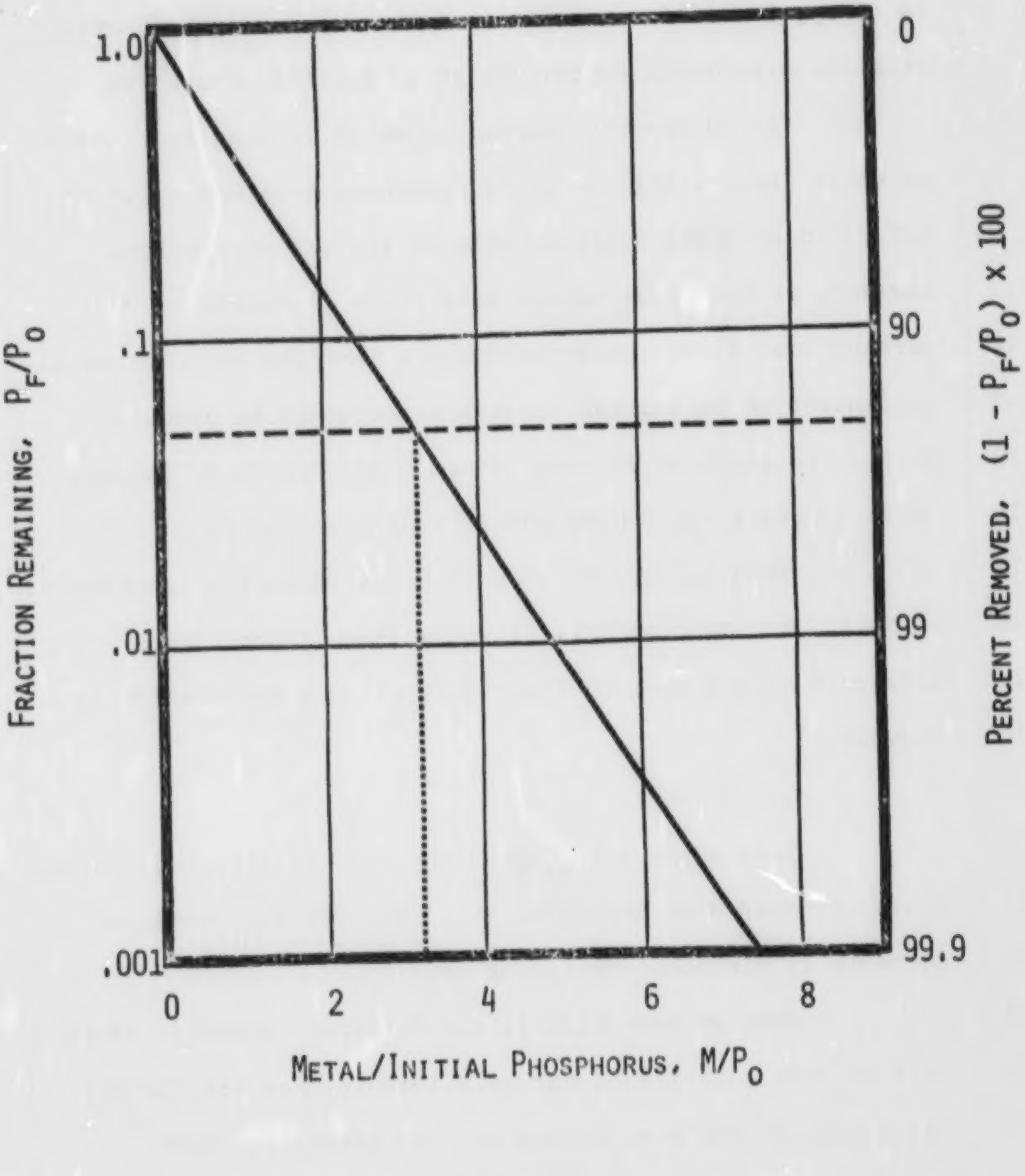
κ_P = EMPIRICAL CONSTANT

296-B

SLIDE #11

PHOSPHORUS REMOVAL DESIGN EQUATION

$$P_F/P_O = \mathrm{EXP}\ (K_P M/P_O)$$



ratio.

You can see that for 80 percent removal, which would be in about that area there (indicating) -- incidentally, I am sorry, I should have said that this is a weight-to-weight relationship, metal concentration to initial phosphorus.

At 80 percent removal -- which is that area about in there (indicating) -- it is something like maybe 1.8 or 1.7 ratio of metal concentration to initial phosphorus. However, if the requirements were to be increased to 99 percent removal of total phosphorus, then the ratio of metal concentration to initial concentration would be about 5. So that is quite an increase from 80 percent to 99 percent ratio of metal ion concentration, less than 2 to 5.

Thus, it can be seen that the removal of phosphorus becomes progressively or -- if you will -- exponentially more difficult as the desired final phosphorus concentration is reduced.

... Slide 12 ...

This slide illustrates the variability of different wastes treated with one metal ion. We left one community on there by mistake. We apologize.

What we have here is six different domestic sewages that we have established our relationship, and the flatter the graph, or the more horizontal the graph, the more

297-A

SLIDE #12

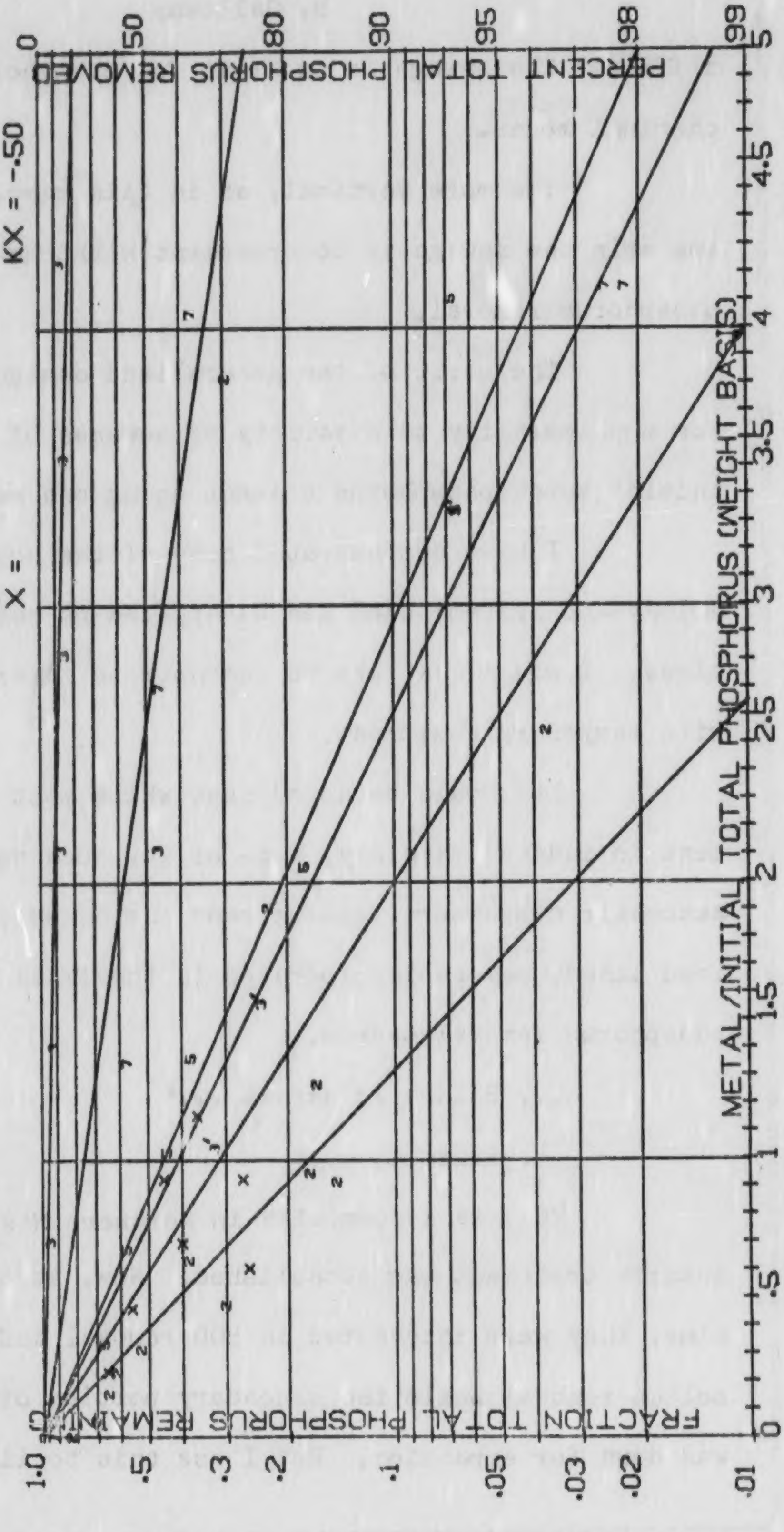
DOW

PHOSPHORUS REMOVAL FEASIBILITY STUDIES
DOMESTIC + INDUSTRIAL SOURCES

VAR FERRIC IRON
0.5 PURIFLOC A23
5.0 MIN MIX
VAR SEWAGE

1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =
0 =
X =

K2 = -.78
K3' = -.38
K3 = -.019
K5 = -.34
K7 = -.12
KX = -.50



difficult the sewage is to treat for phosphorus removal by chemical means.

The more vertical, as in this case, the more amenable the sewage is to treatment with chemicals for phosphorus removal.

The merit of the generalized design equation is its applicability to a variety of sewages of differing initial total phosphorus content using one metal system.

I have demonstrated some of the sophisticated technology and systems that can be applied to permanent installations. I would now like to demonstrate interim treatment with temporary equipment.

It should be noted that while most of this equipment is indeed temporary, some of it, such as storage tanks, automatic dispersers, and in some instances feed pumps and feed lines, may be incorporated in the final permanent phosphorus removal system.

... Slides 13 and 14 ...*

... Slide 15 ...*

This is a community in northern Wisconsin where interim treatment was established. Now, at this particular time, they were interested in BOD removal and suspended solids removal while the secondary portion of their plant was down for expansion. But I use this to illustrate

*(NOTE: Slide could not be reproduced.)

interim treatment for phosphorus removal as the same type of system and equipment is used. Here they are using a metal ion and an organic flocculant for removal of suspended solids and BOD. Total phosphorus was also run during this interim treatment.

I would like for you to note the simple feed lines and pump arrangement for administering the multiple feed.

... Slide 16 ...*

Here a multiple speed selector provides accurate metal ion feed rates. In other words, the treatment plant operator -- this particular plant was a 3 mgd plant, and the treatment plant operator about 6 or 8 times a day will take a measurement of flow off the flow meter of the hydraulic load of the plant, and make his adjustment on this selector for the coagulant feed.

... Slide 17 ...*

With this slide, I would like to demonstrate two methods of administering coagulants that we found successful: 1) obviously pumping the metal cation; and 2) we have also had some good experience with feeding by gravity flow with the flow meter.

... Slide 18 ...*

I hope you can make this out. In the left-hand corner there is an automatic dry polymer feed disperser,

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*(NOTE: Slide could not be reproduced.)

D. Galloway

which we certainly think is necessary in interim treatment for plants, as I indicated, 3 mgd or greater, where there is a certain amount of labor required in mixing the flocculant manually, and this piece of equipment certainly diminishes that manpower need considerably.

In our experience with plant scale trials and interim treatment contracts, normally 6 months in duration, the costs for the leased equipment and service have averaged 10 to 15 percent of the total cost. A contractor like Dow, who provides this service and has equipment readily available, can set up the chemical feed equipment in about 2 months. A period of several weeks after installation is required to optimize addition points and chemical dosages.

... Slide 19 ...

To give you some idea of the activity around the lakes, this is a compilation of some of our experience so far.

I would like to conclude my paper with two slides on operating and capital costs.

... Slides 20 and 21 ...

For the record, this slide includes the following costs: for plant sizes less than 1 mgd, the estimated chemical cost, $35 to $45 per million gallons; 1 to 10 mgd size, $30 to $35 per million gallons; 10 to 25 mgd size,

SUMMARY OF APPLICATIONS OF THE DOW PHOSPHORUS REMOVAL PROCESS

STATE	FEASIBILITY STUDIES	PLANT TRIALS	STATUS OF APPLICATION* DESIGN	CONSTRUCTION	OPERATION	EFFLUENT CRITERION FOR TOTAL PHOSPHORUS
MICHIGAN	19	11	27	21	12	80% REMOVAL
ILLINOIS	--	--	--	--	--	85% REMOVAL
INDIANA	3	--	1	--	--	80% REMOVAL
MINNESOTA	--	--	--	--	--	<1 MG/L
NEW YORK	8	3	6	--	--	<1 MG/L
OHIO	6	2	5	2	--	INDIVIDUAL PLANT STANDARDS
PENNSYLVANIA	2	--	1	--	--	85% REMOVAL
WISCONSIN	3	2	1	--	--	85% REMOVAL
U.S. TOTALS	41	18	41	23	12	
ONTARIO	3	1	--	--	--	80% REMOVAL
GRAND TOTALS	44	19	41	23	12	

*CUMULATIVE FIGURES

CAPITAL COSTS FOR PRIMARY PHOSPHORUS REMOVAL

PLANT SIZE (MGD)	CAPITAL REQUIRED ($)	CAPITAL COST ($/MIL GAL)*
<1	$ 5,000 - $ 10,000	$3.50
1 - 10	12,000 - 25,000	3.28 - 0.68
10 - 25	30,000 - 50,000	0.82 - 0.54
25 - 100	50,000 - 75,000	0.54 - 0.20
>100	75,000 - 150,000	0.40

*BASED ON TWENTY-YEAR STRAIGHT-LINE DEPRECIATION AT 5 PERCENT INTEREST

CHEMICAL COSTS FOR PHOSPHORUS REMOVAL

PLANT SIZE (MGD)	CHEMICAL COST ($/MIL GAL)
<1	$35 - $45
1 - 10	30 - 35
10 - 25	25 - 30
25 - 100	22 - 25
>100	20 - 22

$25 to $30 a million gallons; and 25 to 100 mgd size, $22 to $25 per million gallons treated; and greater than 100 mgd size plant, $20 to $22 per million gallons treated.

These data on operating costs are based on 80 percent removal of total phosphorus, at an initial concentration of 10 mg/l of total phosphorus using ferric chloride and an anionic polyelectrolyte. These average costs reflect freight rates from Midland, Michigan to other points in Michigan.

This will give you some idea of our estimates on capital requirements for getting set up for primary treatment of phosphorus removal. We are talking about permanent installation; we are talking about -- this particular slide includes tanks, feed lines, pumps -- it does not include, say, administration buildings.

To reiterate a few of the points, I have talked about how new technology has been put to practical use in permanent phosphorus removal installations in some of the larger plants.

I have discussed establishing interim treatment for phosphorus removal, and I have concluded with comments on capital and operating costs for permanent installations of phosphorus removal.

Thank you very much.

MR. MAYO: Mr. Galloway, for purposes of the record, we will want a set of slides to go along with your statement. Will it be possible to make that arrangement?

MR. GALLOWAY: A set of slides or reproductions?

MR. MAYO: Reproductions.

MR. GALLOWAY: I can get that for you. I will get them for you.*

MR. MAYO: Any questions, gentlemen?

Mr. Purdy.

MR. PURDY: Mr. Galloway, in your presentation, you indicated a 20 percent increase in solids to be handled; a 20 percent increase over what? I mean from a primary plant to 80 percent phosphorus removal, or an activated sludge plant to 80 percent?

MR. GALLOWAY: Well, this is based on primary removal, and it is an overall increase of 20 percent.

MR. PURDY: If you had a primary plant operating today and had, say, one unit of sludge, would you mean to go to phosphorus removal of 80 percent that you, then, would only have to handle 1.2 units of sludge?

MR. GALLOWAY: Did you say a primary plant or primary removal? I am sorry. I missed that.

MR. PURDY: Well, a primary sewage treatment plant -- you are going to put phosphorus removal in it -- are you saying that the increase in sludge volume to be handled now is only 20 percent greater than before phosphorus removal?

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*(NOTE: The color slides were not able to be reproduced for the record and were not submitted by Mr. Galloway for this reason.)

MR. GALLOWAY: As an average. In some cases, we have found it to be at times 50 percent greater; at other times less than 20 percent. It is kind of a rough number admittedly but --

MR. PURDY: I find it hard to reconcile that with a primary sewage treatment plant -- the suspended solids removal certainly is going to be less than 50 percent, and maybe down in the range of 30; and you go to chemical treatment and you are going to up that suspended solids removal to the 70 to 80 percent range. It just seems to me that the volume of sludge that we are talking about here to be handled -- the increased volume -- is substantially more than 20 percent in that case.

MR. GALLOWAY: Well, I think most of our experience has been with plants, of course, that include secondary treatment, and where we do increase the solids in the primary, say, from an average of 30 percent removal of suspended solids to 80 percent removal of suspended solids, we also reduce the amount -- at an activated sludge plant, for instance -- the amount of waste activated. So the compensation there, we have estimated roughly, is a 20 percent increase.

MR. PURDY: Okay. But the point I am trying to make is if you have a primary sewage treatment plant only and you expect to put in some interim phosphorus removal facilities, that the volume of sludge that you are going to have to handle is much greater than 20 percent more than what you handled yesterday.

On an activated sludge treatment plant -- and you put phosphorus removal in -- I am in agreement with you that maybe the increased amount of sludge that you are going to handle is about 20 percent more than you handled yesterday. But your sludge-handling problems, on a primary treatment plant, when you go to interim phosphorus removal may cause some problems.

When you pointed out the capital cost involved with phosphorus removal, did this include additional sludge-handling facilities?

MR. GALLOWAY: No, sir.

MR. PURDY: So this could increase that substantially?

MR. GALLOWAY: Yes, sir.

MR. PURDY: Is that correct?

MR. GALLOWAY: This is only for chemical handling and feed equipment and feed lines to the addition points.

MR. PURDY: Now, were you here yesterday?

MR. GALLOWAY: Yes, sir.

MR. PURDY: Are you in agreement with this estimate that was made yesterday of, say, roughly 40 percent increase -- 40 to 50 percent increase in operating chemical cost to go from an 80 percent removal to a 90 percent removal?

MR. GALLOWAY: Yes, sir. I think I indicated that somewhat on the slide where I showed you the 80 percent removal to 99.9 percent, which is more than double the amount -- at a specific level of phosphorus --

MR. PURDY: Yes, you just didn't stop at the 90 percent.

MR. GALLOWAY: No, I didn't, but I do agree with Mr. Barth's statement, yes, sir.

MR. PURDY: And in your slides, your presentation, you indicated the ease that one can go into an interim phosphorus removal operation, that this might be the simple addition of some tanks to house chemicals and feed pumps, and so forth, to feed those chemicals.

Your slide indicated an operation in Wisconsin certainly under adverse weather conditions. Do those adverse weather conditions require consideration in those interim facilities?

MR. GALLOWAY: Yes, sir. In particular, the coagulant -- I am sorry -- the flocculant feeding system is insensitive to cold weather.

MR. PURDY: So that all piping, pumping equipment, and so forth, must be protected?

MR. GALLOWAY: Must be insulated in the extreme climates, yes, sir.

MR. SCHRAUFNAGEL: Is there any change in efficiency with the colder temperatures?

MR. GALLOWAY: No, sir, not significant.

MR. SCHRAUFNAGEL: Mr. Galloway, in one of your slides, you showed the concentration of metal -- of it being added directly or in your relationship between that concentration and the percentage removal. Was this concentration, that you are speaking of, in percentage removal, based on the total phosphorus or was it based on the orthophosphate?

MR. GALLOWAY: On that particular slide it was based on the side of phosphorus. A relationship like that can be established for the total phosphorus, too, and can be just as meaningful in predicting amounts of coagulants necessary for increased removals of phosphorus.

MR. SCHRAUFNAGEL: Well, you wouldn't be apt to get up to 99 percent removal of total phosphorus.

MR. GALLOWAY: That's right. Yes, sir.

MR. McDONALD: Mr. Galloway, how many interim phosphorus removal facilities do you have on line now?

MR. GALLOWAY: We have several proposed. We have none on line.

MR. McDONALD: And how long do you estimate it would take you to set up -- if you got an order today -- to go forward with that job?

MR. GALLOWAY: About 2 months.

MR. McDONALD: And what would be the cost of the setup, or would there be a cost to the community?

MR. GALLOWAY: That is a little complicated. Our proposals to communities have been based on a price per million gallons and, as I indicated, most of our proposals are based on 6-month interim treatment; and for a 6-month period of time, the service and equipment -- rental portion of that contract -- is about 10 to 15 percent of the total cost. That leaves 85 to 95 percent for the chemical coagulant and flocculant cost.

So, to clarify that, our contract would be -- or any contractor's contract -- we are suggesting would be for the total package: a price per million gallons for chemicals, service, and equipment.

MR. McDONALD: In other words, for a 6-month term you would give one billing?

MR. GALLOWAY: Yes, for practical purposes, yes, sir.

MR. McDONALD: I see. Are the two that you have in the Lake Michigan Basin the two jobs that you are pursuing now?

MR. GALLOWAY: Yes, sir.

MR. McDONALD: Is your company prepared to handle a pretty good quantity of interim phosphorus removal jobs?

MR. GALLOWAY: Yes, sir.

MR. McDONALD: Thank you.

MR. HERT: Do you have a liquid polymer that would further simplify the process of chemical additions?

MR. GALLOWAY: No, sir. I take exception to that, but no, sir.

MR. MAYO: Are there any other questions, gentlemen?

MR. PURDY: Yes.

When you stated 2 months'time to put in interim facilities, does that include those extras needed to take care of the adverse weather conditions?

MR. GALLOWAY: Yes, sir.

MR. PURDY: And to do this, you are making the assumption that the plant has adequate sludge handling facilities, the 2 months' time will not allow for --

MR. GALLOWAY: That is true.

MR. PURDY: -- any increased equipment that might be necessary for sludge handling?

MR. GALLOWAY: That is true, and as I indicated that can be a real problem.

MR. MAYO: Any further questions, gentlemen?

MR. FRANGOS: Yes.

Could I just run through those cost figures again? What would be the leasing cost for a community served by a 1 million gallon per day plant?

MR. GALLOWAY: That is tough. It would depend on the first step of this operation, which I didn't mention, and that is a feasibility study or some initial laboratory work, and maybe hydraulic flow studies of the plant.

I can't give you a specific number for a 1 mgd plant; I can only tell you, as I indicated before, a percentage breakdown in cost.

MR. FRANGOS: Which was 10 to 15 percent additional?

MR. GALLOWAY: Yes, for leasing and manpower requirements to get the interim treatment started, and maintenance of equipment.

MR. FRANGOS: Thank you.

MR. MAYO: Mr. Galloway, one of the problems that is characteristic of the smaller plants is the difficulty that operating personnel have with the maintenance of equipment -- particularly the automated equipment.

What kind of service would generally be available?

MR. GALLOWAY: For the smaller plants, as I illustrated on the slide -- now that community in Wisconsin was a 3 mgd plant -- and I broke this down mainly in three groups: 1) 0.1 mgd size plant; 2) 3 mgd size plant; and 3) 50 or 100 mgd size plant, where more automatic type equipment is required.

For the smaller plants, say, less than 3 mgd or less than that, the sophistication isn't very great at all. You saw the pumps and feedlines that we had installed at this location in northern Wisconsin. The only piece of sophisticated equipment is that automatic polymer disperser that we installed. And I think that, with our guidance, or the contractor's guidance, these treatment plant operators can be taught to operate that piece of equipment. Part of the service that we offer -- or that a contractor offers -- is that if there is a problem with addition points or dosages any time during the trial, then that technical service -- our technical service is available. But from the standpoint of operating the equipment, there should be no problem, and we have experienced no real difficulty in that after we have been there for some time and have had the opportunity to instruct the people, the plant personnel.

MR. MAYO: Any other questions, gentlemen?

Thank you, Mr. Galloway.

MR. GALLOWAY: Thank you.

MR. BRYSON: The next statement that we have on the Phosphorus Technical Committee report is a statement prepared by Mr. Arthur H. Cratty, Commissioner, U.S. Department of Agriculture, Great Lakes Basin Commission. Mr. Cratty was available yesterday to present this, but could not stay over.

The statement is 4 pages in length, and I think it would be appropriate to read it into the record so that the conferees have the benefit of what it says. He did not leave sufficient copies for distribution.

STATEMENT OF ARTHUR H. CRATTY, COMMISSIONER,
U.S. DEPARTMENT OF AGRICULTURE,
GREAT LAKES BASIN COMMISSION,
EAST LANSING, MICHIGAN
(AS READ BY DALE S. BRYSON)

MR. BRYSON: Mr. Chairman and members of the Lake Michigan Enforcement Conference.

I appreciate the opportunity to make a statement to this conference. My statement relates to the report of the Phosphorus Technical Committee, in particular to the section of the report entitled, "Non-Point Sources" which begins on page 13 and continues through page 15.

My purpose is threefold: 1) to update the USDA report presented at your February 1969 conference; 2) to further explain the conservation programs of USDA, with particular reference to the Lake Michigan drainage area; and 3) to correct some apparent misunderstandings stated in the committee's report.

In 1969 we pointed out a definite need to: 1) expand technical and financial assistance for installing special measures for pollution control; 2) increase long-term credit and cost-sharing for the installation of erosion control measures; 3) provide further assistance to local government in effective erosion and sediment control programs in urban and industrial developments; 4) provide additional financial and technical assistance for the formulation of model regulations; and 5) the need for other authorities to control erosion along highways, streambanks, lakes, and strip-mined areas.

We are pleased to report that the recently enacted Rural Development Act of 1972 contains provisions for long-term contracts for cost-sharing of land treatment measures, with particular emphasis on small watershed projects. This means we can develop plans with landowners for installation of conservation practices with assurances for cost-sharing on a definite time schedule over a period of years. The Act also broadens our authority in watersheds to deal with all land, not just that related to water management measures. Still further, it contains authority to include features specifically to improve the quality of water in streams. Procedures are now being developed to implement this new authority.

We agree that sediment is a serious pollutant. It is impractical, however, to assume that erosion can be reduced to zero. A reduction by 70 to 75 percent of untreated rates is a practical limit.

Land use in the Lake Michigan Basin consists of approximately 13.0 million acres cropland; 1.4 million acres pastureland; 12.6 million acres woodland; and 5.2 million acres urban and related uses -- a total of 32.2 million acres. Conservation cropping systems have been applied on 30 percent of the cropland, 3.4 million acres; with .4 million acres supporting mechanical practices. About 44 percent of the cropland in the Lake Michigan Basin presently has adequate conservation treatment. Approximately 375,000 acres of pastureland have been adequately treated. This represents 27 percent of the pastureland. Four and fivetenths million acres of woodland have received treatment. This represents approximately 36 percent of the forest land. In view of these statistics, we believe the agricultural programs in the basin have been very successful, and that the soil conservation districts are to be commended for their contributions through promotion of voluntary commitments of landowners to a conservation program.

The watershed program is not yet a major factor in the Lake Michigan Basin. Only 23 watershed applications are on hand encompassing about 1.5 million acres, or 4 percent of the basin. Two of the 23 potential projects have been completed, and on these 80 to 90 percent of the land treatment measures have been applied. Contrary to the committee's report, the emphasis in the watershed program, under Public Law 83-566, has not changed from conservation measures to "dams, drainage, and channelization." The first increment in formulating project plans is adequate treatment of all lands for watershed protection. This is supplemented by structural measures needed to achieve agreed-upon objectives. The Act has been broadened several times to make it more responsive to the full range of environmental values.

The committee's report is also in error in stating that the Act requires that conservation measures must be applied on 75 percent of the watershed. The requirements of the Act regarding land treatment are entirely related to the protection of each retention reservoir. It requires that local organizations shall "obtain agreements to carry out recommended soil conservation measures and proper farm plans from owners of not less than 50 percent of the lands situated in the drainage area above each retention reservoir to be installed with Federal assistance." The requirement referred to by the committee for 75 percent application of erosion control measures is for critical sediment source areas which if uncontrolled would require material increase in the cost of construction, operation or maintenance of the structural measure. In the cases of critical sediment source, 75 percent of the needed erosion control measures must be applied before construction money is released. This requirement is contained in the policies for administration of the Act and is more restrictive than the Act itself.

Soil conservation districts in the Lake Michigan Basin and throughout the Nation have for several decades worked diligently to prevent erosion and reduce sedimentation. In the judgment of many, their success and progress has been noteworthy.

Soil conservation districts are responsible for most of the conservation practices now on the land. I commend them for the accomplishments as well as for their wisdom of initiating and carrying on such a vital program since the late 1930's.

The non-point sources part of the report concludes with a recommendation to require compulsory implementation of conservation measures by landowners. It is not my intent to argue for or against compulsory or regulatory provisions. They may indeed have a place in conservation and pollution control programs. As a matter of fact, several States now have sediment and erosion control laws and I understand a good number of other States have such laws under consideration. I suggest that this conference seek the assistance and counsel of USDA and soil conservation districts to move cooperatively forward in the job of controlling erosion and sediment. I am certain that USDA and soil conservation districts would be pleased to cooperate.

I urge that the Phosphorus Technical Committee be requested to reconsider their report to place agriculture programs in the proper perspective and to correct the misunderstandings it contains.

That concludes Mr. Cratty's statement.

MR. MAYO: Any comments, gentlemen?

MR. BRYSON: Mr. Mayo, there is one additional statement that arrived yesterday. This is directed to Mr. Howard Zar, Chairman of the Phosphorus Technical Committee, from Mr. Joseph Garman, President of the Michigan Soil Conservation Districts, Incorporated.

This elaborates in greater detail on some of the points that Mr. Cratty raises, and copies of these two articles, or this information will be distributed to the conferees later in the day.

Let me read Mr. Garman's letter.

STATEMENT OF MR. JOSEPH GARMAN, PRESIDENT, MICHIGAN SOIL CONSERVATION DISTRICTS, INC., MENDON, MICHIGAN

(AS READ BY DALE S. BRYSON)

MR. BRYSON: "Dear Mr. Zar:

"I have reviewed a draft of your Phosphorus Technical Committee report. I cannot help but take exception to some of the statements made in this report. I have special concern about statements appearing on pages 13 and 14 dealing with non-point sources of pollution. It seems that the information is entirely negative in character and tends to minimize the excellent soil erosion control work that has been carried out by soil conservation districts and watershed programs for many years. The report seems to indicate that very little has been accomplished. Anyone familiar with the program knows the erroneous nature of such a statement. Just one example, and there are many: Prior to soil conservation district activities, practically all fruit orchards in Michigan were clean cultivated. It was a mark of accomplishment not to have a weed or blade of grass growing in the orchard. Erosion was widespread and added great volumes of sediment to the water supply. Today one will seldom see a clean cultivated orchard -- sod, mulch, alternate middles and diversions are accepted and widely used practices. Thousands of miles of grass waterways, plantings on critical areas, pasture improvement, minimum tillage are all significant erosion control factors. One-quarter of a billion trees have been planted by soil conservation district cooperators in Michigan alone. Many of these plantings are on critical erosion areas.

"You do not make reference to the tremendous volume of sediment accumulating in our water areas from many land use developments such as highways, shopping centers, subdivisions, etc. We have research data showing that such losses often result in several hundred tons of soil per acre per year. About 1 year ago, a member of the Water Resources Commission stated in reviewing sediment in the Red Cedar River (a branch of the Grand River) that more pollution occurred in the Red Cedar from the construction of the I-96 freeway than occurred from agriculture in the watershed throughout the entire period of history.

"I note a release from Michigan State University Soil Science Department dated September 11, 'The research data showed that there is little need for great concern about phosphorus in either fertilizer or manure being able to move down through the soil into drainage water. The phosphorus from both sources was retained in the surface horizons of the profile.'

"On page 14, you also made reference to PL-566 projects. I don't believe that the statement 'conservation measures must be applied on 75 percent of the watershed' is correct. This is true only on serious hazard areas. I believe 50 percent of the land must be planned above structures. Also on page 14 it is stated that the '566' law has been broadened to where emphasis is on dams, drainage and channelization. We take exception to this statement. The intent of the Watershed Act is to provide for flood protection and control and related agricultural water management. This certainly requires land treatment, but in certain areas with level topography, channelization is a necessity to handle flood waters. Likewise, impoundments to hold back flood water and to provide recreation uses and water storage is a valuable tool. You folks seem to forget that land used for food and fiber and to provide homes for people is part of the environment, too.

"No reference was made in this report about the enactment of soil erosion and sedimentation control ordinances by many local units of government working with soil conservation districts. This is spreading very rapidly in our State. In fact, a statewide soil erosion and sedimentation control bill is now in the process of being enacted by our State Legislature.

"There are many aspects of this situation. However, I believe that the above is sufficient to illustrate why we believe the report is both inaccurate and misleading.

"Sincerely, Joseph Garman."

MR. MAYO: Any comments, gentlemen?

I think that when we get to the point of discussing the Technical Committee report, it might be appropriate to at least have some commentary on the significance of the challenge that both of these statements issue to the correctness of the report on the items dealing with the controls on agricultural land.

We have two other reports.

Do you want to proceed with those?

MR. BRYSON: Early this summer, we received a telephone call asking the Environmental Protection Agency investigate the taste and odor problems that the city of Green Bay was experiencing. As a result of this telephone call, EPA did do some investigation into the problem, and we have prepared a brief report on that investigation.

I would like to call upon Mr. Walter Redmon to present that report at this time.

Following Mr. Redmon's report, the State of Michigan has a report to present on that same subject.

STATEMENT OF WALTER L. REDMON,
AQUATIC BIOLOGIST,
U.S. ENVIRONMENTAL PROTECTION AGENCY,
REGION V, CHICAGO, ILLINOIS

MR. REDMON: Thank you.

My name is Walter Redmon. I am an aquatic biologist with the Environmental Protection Agency in the Regional Office in Chicago.

I will present a report on the specific incident --

MR. MAYO: Would you speak closer to the microphone, Mr. Redmon?

MR. REDMON: I will present a report on the specific incident at Green Bay and a little background, and Mr. Fetterolf will present a more complete report on their study -- the Michigan study.

The city of Green Bay, Wisconsin has, since 1957, taken its potable water from the main body of Lake Michigan near Algoma, Wisconsin. Raw water is taken from Lake Michigan at two intakes located offshore at depths of 55 and 30 feet, respectively, piped 16 miles to a very modern filtration plant, then piped the remaining 10 miles to the city of Green Bay. In the past, occasional flareups of short-term duration of odor in the raw water have occurred, but personnel of the Green Bay Water Department have in general been able to control these with increased chlorination and activated carbon.

In late June of this year residents of Green Bay found their drinking water to have a very strong musty odor. The Green Bay Water Department had begun extensive treatment efforts, but previously adequate methods failed. Mr. Phillip Utic, Department Manager, and his staff experimented with many methods of treatment before choosing a combination of potassium permanganate and activated carbon, which reduced, but did not eliminate the odor. At the same time, Mr. Utic contacted other water departments using the waters of Green Bay or Lake Michigan. He found that the city of Two Rivers, located a considerable distance south of Green Bay's water intake, for the first time experienced similar problems beginning July 4, a few days after odors appeared at Green Bay.

Mr. Utic also found that this outbreak was preceded by several days of northerly winds, which tend to create a north-south current along the west shore of Lake Michigan. This fact indicates that the source of these odors was located to the north of the Green Bay intake.

Since 1970, the cities which use Green Bay itself as a water supply have been experiencing increasingly severe taste and odor problems. A 1972 investigation conducted by the Michigan Water Resources Commission provided considerable evidence that the problem was caused by actinomycetes fungi. Geosmin, a metabolic by-product of these fungi was identified in the affected water treatment plants. Geosmin is a very potent organic compound which produces characteristic musty odors at extremely low concentrations.

EPA personnel first became involved on July 10, 1972. On July 13, and 20-21, water samples were collected and taken to EPA laboratories in Cincinnati, Ohio. In both cases, these samples proved too small for successful analysis. Drs. A. A. Rosen and R. S. Safferman, EPA scientists, who have broad experience with tastes and odors in water, were consulted for guidance.

There is no adequate method of water treatment to completely solve a major taste and odor problem of this type. The methods being used by Green Bay personnel were the best available. Research on water treatment methods to remove odor compounds needs a much higher priority than it currently holds.

The source of the problem remains only partially proven. Samples of activated carbon removed from the Green Bay water treatment plant's filters and settling basin were flown to Cincinnati in early August for analysis. Since activated carbon collects and concentrates many organic compounds, solvent extraction and chromatographic analysis is the best method for confirmation of the odor causes. The human nose is more sensitive for detecting organic odor compounds than available analytical equipment. An experienced investigator can identify many compounds at concentrations far below the sensitivity range of the best analytical equipment currently available.

Results of EPA chemical analysis did not positively identify the presence of geosmin or any other known odor-producing substance. There was a strong indication that geosmin was present in the filter carbon, but in concentrations too low for positive identification. The analytical equipment used was the best there is. The chemists said they could smell a musty odor typical of geosmin, but couldn't make positive identification.

Following 2 days of westerly and southerly winds, the odor level of Green Bay's raw water dropped to very low levels on August 3, 1972, after about 5 weeks. The citizens of Green Bay were greatly relieved, but those of us trying to track down the source of this problem were temporarily stopped.

The feeling of those investigating the problem is that eutrophication of Green Bay due to inflow of organic materials, and other nutrients, especially phosphorus and nitrogen, is the cause of an increasing taste and odor problem in the bay. Waters of Green Bay, which are discharged to the main body of Lake Michigan, are then the logical source of the problems recently experienced at Green Bay, and Two Rivers, Wisconsin,water intakes along the western shore of the lake.

Actinomycetes have been identified from samples taken throughout Green Bay. These fungi exist on decomposing organic matter such as dead algae. The investigation conducted by the State of Michigan also revealed bottom deposits of organic materials throughout Green Bay.

Green Bay exhibits many characteristics of rapid eutrophication. Many large point sources of inadequately treated wastes continue to discharge to the bay's tributary streams. Until these pollution sources are controlled, taste and odor problems in water supplies can be expected to remain and continue their increase.

Our summary and conclusions were:

1. There is an increasing problem of taste and odors in water supplies taken from Green Bay and nearby portions of Lake Michigan. This problem has reached significant proportions at the city of Green Bay's intake near Algoma, Wisconsin, and at Two Rivers, Wisconsin, in recent months.

2. Investigations conducted during 1972 by the Michigan Water Resources Commission indicate the presence of actinomycetes fungi and their metabolic by-product, geosmin, a potent cause of odor, in water supplies drawn from Green Bay.

3. Odors which occurred in the city of Green Bay's water supply were typical of geosmin. Analysis of carbon extracts from the city's filtration indicated the presence of geosmin at concentrations below those necessary for positive confirmation.

4. Evidence presently available suggests a definite link between the degraded water quality of Green Bay and taste and odor problems experienced by the city of Green Bay. It can be expected that periodic recurrences

will persist so long as pollution of Green Bay continues.

5. Treatment instituted by the Green Bay Water Department was consistent with best presently available technology; but there is no adequate method to treat this important water supply problem.

The recommendations were:

1. Further investigations to confirm the source of taste and odor problems in the Green Bay area of Lake Michigan should be conducted. Investigations by the Michigan Water Resources Commission have laid important groundwork and should be expanded in conjunction with complementary efforts by the Wisconsin Department of Natural Resources and the Environmental Protection Agency.

2. Research on water treatment methods for removal of odor-producing compounds must be greatly expanded. Such problems are not exclusive to Green Bay. They occur throughout the world. Many water supplies in the United States are degraded in this way. Present water treatment technology provides only partial remedy at drastically increased cost.

3. Michigan, Wisconsin, and EPA should intensify enforcement efforts to abate sources of pollution to Lake Michigan's Green Bay.

Thank you.

MR. MAYO: Any comments or questions, gentlemen?

MR. FRANGOS: Mr. Chairman.

I think that we would endorse the recommendations contained in this report, and indeed I think that at least as far as "1" and "3" are concerned, we can report to you that we are following up on the investigations to see if we can't more specifically pinpoint the causes of the taste and odor situation.

Certainly we are concerned not only about the quality of water delivered, but certainly the increased cost factors that go hand-in-hand with trying to control the taste and odors.

I think we are intensifying our enforcement efforts jointly. However, I am not so sure that there has been a causal relationship identified here and, of course, that is one of the things we will be doing as a followup. But I am not so sure that even if we do indeed reduce pollutants to Green Bay that we may necessarily reduce the frequency of taste and odor problems. I am not sure that we could reach that conclusion at this point in time.

MR. SCHRAUFNAGEL: As you perhaps know, the city of Green Bay gives us water from Lake Michigan, and the Door Peninsula separates Green Bay from the main part of the lake.

The taste and odor problems were not confined only to the city of Algoma and the city of Green Bay; the taste and odor problems were found at the same time -- in fact, the initial investigation was made on the taste and odor problems -- at the Marinette and Menominee, Michigan water supplies.

At this time, we feel that the relationship is somewhat casual, and we would certainly want to investigate it further before making the speculative conclusions that are shown here.

MR. McDONALD: Mr. Chairman, I would like to make a comment on the report also--just give some background that is not included in the report as to why we got in it at all.

The telephone call that Mr. Bryson referred to was from a representative of the Lake Michigan Federation in early July, thinking that the complaints on taste and odor that were being made by the residents of Green Bay were caused perhaps by the thermal discharges coming out of the Point Beach nuclear powerplant. And we responded in this instance really to rule out that possibility or rule it in, and there is no evidence -- although Mr. Redmon did not mention this in his report -- there is no evidence whatsoever that the taste and odor problems were caused by the thermal discharge that is coming out of the Point Beach nuclear powerplant.

Is that correct, Mr. Redmon?

MR. REDMON: I could go into a little more detail there. Mr. Utic has been keeping wind direction records and trying to relate these to the actual occurrence of taste and odor problems. I think in a little less than a year there have been four instances, although the other three were quite small and lasted for only a few days, where taste and odor problems occurred.

In each case, the wind direction was directly correlated to the taste and odor problem. The wind direction was from the north or northeast in each case where this happened, and it had to occur -- the wind direction occurred for several days. We had several days of north winds, which would instigate a southward current, and this preceded each case of taste and odor problems that have been reported so far.

There has been an abatement of this problem when the wind direction changed for a period of several days and pushed the currents back in the other direction, when the currents of Lake Michigan started coming from the south, which is the location of the nuclear powerplant in question.

MR. MAYO: Any other comments, gentlemen?

Thank you, Mr. Redmon.

MR. BRYSON: Mr. Fetterolf, are you presenting the statement for Michigan?

MR. FETTEROLF: Yes, Mr. Bryson.

STATEMENT OF CARLOS FETTEROLF,
CHIEF ENVIRONMENTAL SCIENTIST,
MICHIGAN WATER RESOURCES COMMISSION,
LANSING, MICHIGAN

MR. FETTEROLF: Mr. Mayo, conferees, ladies and gentlemen.

Historically, the Michigan cities adjacent to Green Bay have utilized it as a raw water source with virtually no reported unpleasant taste and odor occurrences. Recently, the Michigan communities of Menominee, Escanaba, and Gladstone have experienced a strong musty odor in the water supply, "strong enough to drive you out of the shower," in the words of one resident.

The initial occurrence was noted in the late summer and fall of 1969 in Menominee. The following year, 1970, again in the late summer and fall, the city of Escanaba, as well as Menominee, experienced this phenomenon. Strong odors initially occurred in the late summer and early fall, reached a maximum intensity in midwinter (December), continued to be noticeable the remainder of the winter months, and disappeared in early spring (April). This annual pattern reoccurred in 1971 and odors in the raw material.

Geosmin is a soluble, organic metabolite synthesized by certain blue-green algal species and by certain actinomycetes. Geosmin has a strong earthy-musty odor similar to that detected baywide during the survey. Actinomycetes are a group of fungus-like bacteria very common and widespread in both land and water environments. They are saprophytes, receiving their energy from nonliving organic materials.

Actinomycetes are often associated with taste and odor problems in water supplies. In Survey I, actinomycetes were not identified, and I believe the reason they were not identified was because we used a nonspecific culture medium in the laboratory and our results were simply inconclusive.

Survey II, conducted May and June 1972, again found odor present baywide algal densities again considered much too low to cause an odor problem; and the presence of 15 to 200 colonies of actinomycetes per ml of water and greater than 8,500 colonies per ml of sediment. During this survey, actinomycete-specific culture was used and the bacteria responded well.

Survey III samples collected in August were cultured in a more precise manner than the others and we are now finding 60 to 1,560 colonies of actinomycetes per ml of water are occurring now. The intensity of the odor, most often described as musty, has increased from 1969 to the present. Threshold odor number determinations now indicate the presence of a musty odor in raw water throughout the year.

Extensive, but temporary, water treatment modifications are presently employed by the facilities in all three communities. These additional processes double the chemical costs of treatment and are not particularly effective in eliminating the odor. These communities not only seek immediate relief, but wish to determine their future potable water treatment needs with respect to this problem. The identification, then, of the musty odor sources and the possibility of control in Green Bay would aid these communities in their long-range water supply planning.

City officials at Escanaba asked the staff of the Water Resources Commission for assistance in determining the cause and extent of the odor problem in early 1972. Our first water quality survey relating to the odor problem of Green Bay was conducted in February and March 1972.

Survey I showed that odor was present throughout the bay at all depths; algal densities were considered too low to be the cause of the odor; geosmin was present on the carbon used by the water treatment plants as filtering water and up to 1,250,000 colonies per ml of sediment.

This increase in figures does not necessarily represent a true increase in the counts of actinomycetes. It is simply that we have gradually been refining our analytical techniques and our culturing techniques.

To date we have not been able to correlate the actinomycete counts with intensity of odor because our initial cultural techniques were simply too unrefined. Future work is planned on this problem as well as the problem of quantifying the concentration of geosmin in bay water. A bacteriologist and chemist have worked part-time on these problems, but more intensive effort is called for. To date we are not claiming we have proved that actinomycetes or geosmin are the cause of the odors, but we are very suspicious.

Michigan has occasional similar odor problems in Saginaw Bay and you have just heard of a related problem in Lake Michigan at the Green Bay intake.

We are drafting a proposal for a 2-year research grant which will permit us to gain further understanding of this problem which can affect so many people of our State.

The proposal will include:

1. Refinement of culture techniques for actinomycetes from both water and sediments.

2. Refinement of collection and extraction techniques so that concentrations of geosmin can be quantified.

3. Correlation of actinomycetes populations with geosmin concentrations.

4. Correlation of actinomycetes and geosmin with odor intensity of the water.

5. Comparison of actinomycete populations in situations both similar and dissimilar to Green Bay in selected portions of Michigan's Great Lakes waters.

6. Comparison of actinomycete populations where odor problems occur and do not occur.

7. Identification of water and sediment qualities which encourage actinomycetes growth with emphasis on organic content of the sediments.

8. Correlation of actinomycete populations and odor problems with limnological and other biological phenomena.

9. Determination of organic carbon concentrations in the bay and determination of the sources and annual budget.

10. Finally, prediction -- hopefully -- of the future odor problems in Green Bay, other estuarine water supply sources, and in Lake Michigan proper.

Thank you.

MR. MAYO: Any comments or questions, gentlemen?

MR. SCHRAUFNAGEL: Carlos, will there be any consideration given to current studies at the same time?

MR. FETTEROLF: I would think that was very important. I said there was no correlation between actinomycete counts and odor intensity, but with that odor present baywide, we definitely have a trend to higher odors in the vicinity of the southern end of Green Bay, and with the new information about the north winds affecting the water supply at Green Bay in Lake Michigan, it seems apparent that there might be a massive water replacement occurring in Green Bay so that the water mass from Green Bay is moved out to Lake Michigan and down southward along the lower peninsular shore to Green Bay. And so I would say that current studies are certainly in order.

MR. MAYO: Any other questions, gentlemen?

I have one, Mr. Fetterolf.

In Mr. Redmon's statement, he commented on the difficulty of a positive identification of geosmin. On the carbon used at the treatment plant, in your statement, you say flatout geosmin was present on the carbon.

MR. FETTEROLF: When we first started doing this work, we were filtering 50 gallons of bay water through carbon and attempting to identify geosmin on the carbon.

We could detect an earthy-musty odor similar to geosmin but we could not identify it from these samples.

However, when we took samples of the filter media from the water treatment plant, I believe our chemists were confident that they were identifying geosmin.

Would you correct me on that, Pete?

MR. BRYSON: Pete, why don't you come up to the microphone.

MR. REDMON: I can support that a little further. At the same time that the samples we just sent to Cincinnati were analyzed, a sample which had been sent by the State of Michigan to Cincinnati in March, I believe -- either March or May -- was analyzed along with these, and there was positive confirmation of geosmin with gas chromatograph and mass spectrograph. There was definite analysis, and identification of geosmin was there, and so I don't know whether this has been actually confirmed in the past by Michigan with mass spectrograph, but this has been done now. And this was from an old sample that had been sitting in the refrigerator for several months. There was a much higher concentration, and this was a sample from the Menominee-Marinette area from the carbon filters there.

MR. BRYSON: Mr. Mayo, with respect to your comment, the sample that was sent to Cincinnati was not large enough to get into the detectability range, if I remember right.

MR. REDMON: No, there is just a — it is a little different from that. The detection of geosmin is one thing; positive identification with mass spectrograph is another. They were able to detect a substance located at the proper point in the chromatographic chart, shall we say, to be identified as geosmin. However there was not enough of it present to go through the mass spectrograph analysis for positive confirmation.

MR. MAYO: Thank you.

MR. FETTEROLF: Mr. Mayo, I would like to insert in the record a statement from one of our staff's early reports on this.

"The activated carbon obtained from the carbon filters of various water treatment plants was analyzed by gas chromatography. The chromatogram so obtained was compared with a chromatogram resulting from a known sample of geosmin. The peaks matched well indicating the presence of geosmin in the carbon filters."

MR. MAYO: Thank you.

Any other questions, gentlemen?

MR. FRANGOS: Mr. Chairman.

I would just comment very briefly on some of the work that we have undertaken. We have done some sampling since the tail end of the summer. More recently we have sampled about 70 stations on the bay, and these are presently being cultured, but we hope to see if we can't get some population estimate and perhaps a correlation of plankton populations with perhaps other water quality parameters.

Interestingly enough, in some of our water samples that we collected where there was no characteristic odor at the time we initiated the culture, sure enough those developed later. I am not sure what that means with regard to Mr. Fetterolf's research proposals.

MR. MAYO: Any other comments, gentlemen?

I think it might be appropriate, at this point in time, before getting back to the Technical Committee report, to take a 15-minute break and recess until 10:55.

(Short recess.)

MR. MAYO: May we have your attention, ladies and gentlemen?

The conferee from Illinois, Mr. Blaser, had to leave the table for a few minutes; he indicated he would be back very shortly and he suggested that we move right ahead with the program.

Gentlemen, we have before us the report of the Phosphorus Technical Committee, and the related commentary.

I believe we can address our attention, at this point in time, to both the committee report and the related supplementary material that has been presented to the conferees.

You can proceed as you desire.

MR. PURDY: I would like to ask some questions of Mr. Zar.

In the Technical Committee report on page 11 -- on the increased cost of moving from the 80 percent to the 90 percent -- this states roughly a $10 per million gallons increase.

The slide that was shown by Mr. Galloway indicated that this would be true if the plant, say, I believe, were in the neighborhood of 25 to 50 million gallons per day -- that the smaller plant would be somewhat higher.

Are you using roughly this 40 percent increase in cost when you go from the 80 percent to the 90 percent level?

MR. ZAR: The committee's estimate was based on some figures prepared for it by the EPA Advanced Waste Treatment Laboratory in Cincinnati. Perhaps we could have those figures put before you.

MR. PURDY: I am just wondering if there is any difference in this assumption of roughly a 40 percent increase as indicated by this $10 per million gallons.

MR. ZAR: I think that they are fairly similiar.

I can't really resolve them.

MR. PURDY: The other question that I have relates to the additional chemicals now that will be necessary if we move from an 80 percent to a 90 percent level. And is there any concern on the part of the Technical Committee of the increased dissolved solids that will be contributed to the lake so that we can remove additional phosphorus?

MR. ZAR: I don't know that the committee discussed that issue specifically. There is a subsequent report directed towards the dissolved solids problem. Perhaps that would be the place to take that up.

MR. PURDY: I am concerned that we proceed on these issues separately. On one hand, we say we should move to a higher phosphorus treatment level, and then on another issue we consider that separately, and say that we must control the dissolved solids additions to the lake, that this is increasing, that this also has an effect upon the nutrient value of the Lake Michigan waters. So, therefore, we must control the dissolved solids.

It seems to me that we have got to make an analysis of where we accomplish the greatest control, and if phosphorus removal represents a means of controlling the algal growth in the lake, then we must accept some additional dissolved solids to do this.

MR. ZAR: I believe that is correct.

I think that the committee's view probably would be that the phosphorus issue is a more critical issue at least at this point in time, and we are bound to try to achieve the phosphorus reduction at the same time that we continue to worry about the dissolved solids issue.

MR. PURDY: I think we must understand that at this point in time because now, as Jimmy Vaughn's successor might appear at future conferences and show a continuing increase in dissolved solids, that by controlling phosphorus, we are contributing to that dissolved solids increase, is that not correct?

MR. ZAR: That is correct.

MR. MAYO: Are there any other comments, gentlemen?

MR. HERT: Mr. Chairman.

I'd say, yes, we have had these comments on the agricultural sedimentation. I wonder if we could have those available -- the person who did the preliminary work on this aspect make a short statement on the accuracy of the information that was in the committee report, if he is in the audience.

MR. ZAR: That is fine.

MR. MAYO: Please introduce yourself, Mr. LaVeille.

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MR. LaVEILLE: Yes. I am Will LaVeille, Agricultural Waste Specialist for the EPA, Region V, here in Chicago.

The exact content of these two concepts we heard read this morning -- the one from Mr. Cratty at the Great Lakes Basin Commission and also Mr. Joseph Garman of the Michigan Soil Conservation Districts, Incorporated -- the details were unknown to me before this morning, so I have quickly taken notes and I would like to start off by responding directly to some of the statements that they made that the report was inaccurate and possibly in error.

Mr. Cratty felt that there was a feeling within EPA that the Soil Conservation Service efforts had not been adequately recognized. I think that this is not true. EPA does recognize the efforts of SCS, of the U.S. Department of Agriculture in general, and specifically in the great work that they have done over the past years, since their formation in the dustbowl days, in cutting down erosion from the land.

The argument that we have, or the concern that we have over the programs is not one of what they have done, but maybe the fact it hasn't been enough.

There is a Great Lakes Basin Commission report in various stages of draft right now that indicates -- and this report, by the way -- the specific volume that I am referring to is Appendix 18, the erosion and sedimentation discussion.

It was done in part by the Soil Conservation people themselves, and right on the first page of this report, there is mention that only 75 to 80 percent of the erosion that used to take place is still continuing. In other words, to reverse that, between 20 and 25 percent of erosion that used to occur has been halted by the SCS efforts to date.

So in spite of the tremendous number of miles of the branch waterways and terraces, in spite of the tremendous numbers of areas and square miles of various conservation plans, crop rotation, and the like that have been installed, only 20 to 25 percent of erosion has been abated by these measures. The Soil Conservation Service has, over the past 2 years -- as Mr. Cratty pointed out -- provided technical assistance for installing special measures for pollution abatement. Their technical workload has increased significantly over the past few years since the Agricultural Conservation Stabilization Program. The Rural Environmental Assistance Program has provided for cost-sharing to assist farmers to install pollution abatement equipment on the farms.

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The technical design and evaluation load has fallen on the SCS and they have done an extremely adequate and capable job in these lines. They have provided assistance to local governments and to the State governments in implementing certain technical guidelines for erosion abatement. They have worked with urban land developers. They have worked with the county and the State highway departments to try to get up-to-date, technically feasible, economically feasible programs installed for abating pollution in road and housing development construction.

Mr. Cratty also pointed out in his letter that the recent Rural Development Act provided for long-term contracts for land treatment needs, and made the provision further through the SCS, they "can develop plans with landowners." I think this word, the verb "can" is probably the hinge to the difference that the EPA and the Soil Conservation Service have on this.

The Soil Conservation Service can provide these activities. There is no compulsion that the agencies that receive their technical guidance and these suggestions or recommendations for abatement actually install them. It is purely a voluntary program.

Now, perhaps the Rural Environmental Assistance Act will alter this and may contain enough of the financial inducement to make these programs more acceptable to the land users, but to date it has been totally a voluntary effort. I think this voluntary effort is exemplified by the fact that only 20 to 25 percent of the erosion has been abated.

The comment was made correcting the numbers that were used in the Phosphate Committee's report about this 75 percent requirement for the completed structures before the governmental money went out on these Public Law 566 programs.

This PL-566 program, by the way, is called the Small Watershed and Flood Prevention Program. It is specifically designed to hold the waters on the land rather than letting them get into the streams where they overcharge the banks and cause floods.

The explanation that I have heard most recently is that in most cases only 50 percent of the structures have to be applied, have to be constructed and in operation before the Federal money is given. Mr. Cratty is correct in pointing out that 75 percent must be applied in these critical areas. But generally speaking only half the land has to have these conservation measures applied which, in some way, explains why many of the multiple-purpose dams and reservoirs, the flood-retaining structures, silt up at a much faster rate than they were originally designed to do.

The Soil Conservation Districts, which are established under a State charter, have also done an extremely adequate job. This is getting the erosion and soil conservation capabilities down to the local level. The Soil Conservation Districts are managed by elected landowners from that particular community. They are respected people. They have the backing of the local people and therefore they can get a job done much better than somebody at a Federal or a State level can who does not have the implementation at work to get down to the actual people that are involved with it.

The Phosphorus Committee report also had a recommendation for suggesting compulsory requirement for certain erosion control measures before Federal funding could be given out. The purpose behind this was to make aware, make the public aware, of the lack of the voluntary program's success. There are certain inducements that can possibly be given out. These are being tried by various U.S. Department of Agriculture agencies themselves right now.

There is a pilot program going on right now down in one of the southern Illinois counties to make the set-aside acreage -- these farmers get paid for taking out of production -- to place those acres along the stream banks and thereby leave these areas uncultivated.

If it is not cultivated; if it is not put into row crop production, there is the decreased possibility of erosion taking place. The U.S. Department of Agriculture, the Agriculture Stabilization Conservation Service, is piloting this program, and they report they have had quite a bit of success. The farmers are willing to do this. They are willing to set aside the acreage along the stream bank rather than someplace away from the stream and thereby, putting it right on the stream banks, they accomplish two things: 1) they are getting their money for setting it aside, and 2) also cutting down the direct erosion and stream bank sloughage which causes so much of the sedimentation load.

I also think that the fact that many of the States are considering erosion control legislation, and at least two States have already enacted such legislation, is a further indication that there is increasing awareness that some sort of legal requirements and compulsory action might be necessary rather than reliance totally on a voluntary program.

Going to Mr. Garman's letter, the President of the Michigan Soil Conservation Districts, he points out that the report seems negative in scope, and that the efforts of the SCS has been minimized. And, by way of clarification, I am going to repeat that the Erosion and Sedimentation Committee's own page 1 statement might seem to be a minimization of the efforts to date.

He also makes the statement that we seem to be ignoring the amount of sediment that comes from some areas, from some activities other than agriculture. And I agree that in the final editing of this particular section in the Phosphate Committee report that the emphasis was slanted toward agriculture. This was not the intent. We recognize the tremendous increased quantities of sediment that come from urban construction, road building, and urban land development, where the land is stripped, left to lay bare without any cover for long periods of time, in many cases, before the houses are put on and the land sodded. These do contribute many, many times a normal amount of sediment that would come from an agricultural piece of property.

The fact remains, however, that the ratios between the land and urban development and those in agricultural development could still be construed as placing the largest load nationwide on the agricultural land use activities.

Mr. Garman also refers to the Michigan State

University report coming out in September that: "The research data showed that there is little need for great concern about phosphorus in either fertilizer or manure being able to move down through the soil into drainage water. The phosphorus from both sources was retained in the surface horizons of the profile."

I don't have the exact reference that he makes here -- I am not sure which report he is referring to -- but I do have a report dated 1971 -- no more specific than that -- which is also from the Michigan State University, specifically from the Agricultural Experiment Station, and it is entitled "Nutrient Content of Drainage Water from Agricultural Land." In this research report they give details of tile drainage water -- the waters coming out from under the agricultural land -- and in a number of -- I think it is six -- different soil types and agricultural crop conditions, in no case did they find that the phosphate content of this drainage water was less than 0.01 ppm. In many cases it got three, four or five times that.

Now, it is true that 0.01 ppm is not very much phosphorus, but when you extrapolate this, as was done in the report, the amount could be 0.1 of a pound per acre, and over the 44,000 square miles of land in the Great Lakes Basin, this could by extrapolation amount to 2,800,000 pounds of phosphorus coming from the tile drainage.

Now, it is a technical point how much of this phosphorus is available. I understand that this was brought out in discussions yesterday afternoon. It is still open to conjecture how much of the phosphorus that is dissolved, or how much, for that matter, of the phosphorus that is contained on the sediment particles in adsorbed form is available.

However, I think it is hard to ignore the possibility of 2,800,000 pounds of phosphorus -- the potential for this quantity -- being in agricultural drainage waters. I contend that it is not insignificant, and that it is a matter that should be researched, as is the 2 million pounds which is contained on the soil particles in their adsorbed form.

The erosion and sedimentation discussion, in the appendix from the Great Lakes Basin Commission study, contained a number of maps indicating the relative rates of sediment production and erosion quantities coming from the various portions of the land in the Great Lakes, specifically where Lake Michigan is concerned.

After a careful evaluation of these and calculations to indicate the relative weight of the sediment coming from the various sub-basins in the Lake Michigan area, it concluded that only something like 3.2 percent of the eroded material that comes from the land actually reaches Lake Michigan, but this quantity was in excess of 2 million pounds.

Using a rule of thumb -- and this varies widely depending upon which research paper you are reading and who is doing the research and in which part of the country -- there is typically 1 pound of phosphorus adsorbed per ton of sediment. So the numbers could possibly be as much as 2 million pounds of phosphorus reaching Lake Michigan in the adsorbed state on sediment particles.

I think maybe this answers some of the questions that were raised on those two comments.

Are there any more from the conferees?

MR. MAYO: Mr. Purdy.

MR. PURDY: In your comments relating to the concentration of phosphorus in the tile drainage, say, from the tilled fields, do you have any information what the content of phosphorus would be in the underground waters from untilled fields?

MR. LaVEILLE: Yes, this report did contain some information. It indicated that in most cases untilled soil would contain about the same amount as the tilled materials, at a minimum level. The tilled materials, however, would, in most cases, contribute more, but never less than the natural subsurface flow, and this number was approximately 0.01 ppm, in their groundwater.

MR. PURDY: And our groundwaters do flow towards the surface streams.

MR. LaVEILLE: Exactly.

MR. PURDY: So that really this 2 million-plus pound figure, as you calculated from tile underdrainage, may not be 2 million-plus pounds contributed by agricultural practices, but much of that would have gone through the underground waters even if the fields had not been tilled.

MR. LaVEILLE: I think this would be the case for those uncultivated portions of the basin. On fields where manure had been applied, for example, they found considerably higher amounts of phosphorus in the drainage tile water.

There is a considerable quantity of animals in the Great Lakes Basin, and manure is applied to the land. The manure would contribute excess amounts above the natural drainage.

MR. PURDY: We have worked very closely with Michigan State on these research projects and have contributed some money to them, and I have felt that you left the impression that this 2 million pounds is something that could be controlled by some sort of change in agricultural practice.

I do agree that where you have manure added to the fields that you will have higher levels. But I don't think that this 2 million pounds plus represents something that we can get our hands on by changing agricultural practices; that much of this is due to the contact of the underground waters with natural soil conditions that contribute this phosphorus to the groundwaters.

MR. LaVEILLE: What you say is true, but let me add one point: The tendency, the trend toward higher production from the agricultural lands, in many cases demands that fields that had previously been saturated and not able to be cultivated be put into production just to meet the increasing demand for foodstuffs. Therefore, more and more land is being tile-drained, and this does increase the amount of flow under these agricultural fields. Whereas, in a situation where there is more land use activity, more land use management -- and this is a term that is being discussed quite a bit these days -- if the land were managed so that only those areas which are optimum for agricultural production would be utilized, it would mean less use of tile drainage, and thereby cut down on the amount of drainage water that is reaching the streams and you would be left with mostly just the natural subsurface flow.

I agree that the conferees cannot change the progress and trend in agriculture, but I merely offer this as an explanation for the trend in which productivity is increasing the burden on the streams and on Lake Michigan.

MR. PURDY: I am afraid I don't quite agree with your statement there either because actually acreage of tillable land, at least in Michigan, is going down, at least part of it due to encouragement by government to place farmlands in land banks, and rather than going out to less productive ground and making it tillable, we are encouraging agricultural practices which will increase the production on the remaining acreage so that the farmer makes himself a livable wage.

But I think actually the volume of acres that are being tilled has gone down, and that through our own government practices we are encouraging increase in production on the land.

As we speak about underground drainage and the discussion of what can be accomplished in the way of municipal wastewater treatment, if we would only look at the recycling of nutrients now through application of wastewater effluents upon the land, and recognizing that, in many cases, we are going to be selecting some marginal land because that is land now that can be picked up at an economical cost and placed into a land disposal system, and that to make that land usable for that particular treatment practice, that we must go in and underdrain that land so that it can now accept the wastewater effluent and be cropped, what do you expect that particular proposal to do in the way of increased phosphorus contribution from underground drainage?

MR. LaVEILLE: The project you are referring to is the Muskegon County project, which is one that the EPA --

MR. PURDY: That is only one of many that are being considered.

MR. LaVEILLE: And it is one of the largest ones. There have probably been in excess of a thousand sites across the country, probably since the turn of the century, where there has been recycling of municipal and industrial wastes to the land.

The projects that are adequately managed, from an environmental and from an agricultural standpoint, would be expected to add minimum -- probably not measurable quantities of phosphorus to the underground waters. This stresses, of course, adequate management.

If the land is being used merely as a sink for these wastes and the phosphorus and other nutrients are not being removed, then it would be an environmentally damaging project. The agricultural portion, where the crops are utilizing the available nutrients from the recycling, when they are harvested and removed from the site, they are in effect removing the nutrient. It hinges on proper agricultural management. This is probably the most important phase of that type of an operation.

MR. PURDY: Do you have any, say, thoughts on that system as it relates to producing a cash crop. Say if you have the nutrients at pretty much even balance, do you think, then, that you get maximum crop productivity off that acreage, or do you think if you are going to manage that land for maximum crop productivity that, then, you will have some excess nutrients that will break through to that underground system?

MR. LaVEILLE: That is a two-point question.

I think really that both systems have to be optimized. In specific localities where the environmental balance is more critical, a system like that would have to be managed with the environment in concern. If the system is in a less critically environmental situation, it could possibly be optimized toward the agricultural end. But in both cases you are going to have to take both into consideration.

I think maybe what you are driving at is: If you are anxious -- if a community is anxious to get rid of most of their wastewater and couldn't afford a large quantity of land or the types of climate, cropping condition, soil condition and such that they couldn't raise an optimum crop, what would be the alternatives? And I think in such a case you would have to optimize the removal through agricultural practices.

MR. PURDY: Well, my point that I am really driving at is that if that system is to work most efficiently for pollution control, is that it must be managed for pollution control and not for crop productivity and not to produce a crop that will offset its operating cost, that it must be managed for wastewater control, and that this may impinge upon its value to produce a cash crop that will offset its operating cost.

MR. LaVEILLE: Exactly.

MR. PURDY: Now, from the standpoint of soils that are used in that system, a soil that will accept water rapidly, of course, would be your first choice from the standpoint of the amount of land that would be used, and the rate of application. But will that particular type of soil enhance the retention of the phosphorus or will it enhance the passage of that phosphorus through the soils to the underground system?

MR. LaVEILLE: If you get an extremely permeable soil site, one tending toward a sandy composition, the material will pass through faster than many of the crops that you could plant. There are some deep-rooted plants that you could put on it which might extract more of the nutrients by having the roots come down lower, but you would run into more problems in a sandy soil than you would in a tight soil.

MR. PURDY: That, again, is, I think, another point that we have to keep into consideration in that the normal tendency is to seek a soil that will accept water readily, and when we do that we enhance the possibility that this will break through to the underground water.

MR. LaVEILLE: Right.

MR. PURDY: The only other comment that I have is that, as we criticize a sister agency on its past performance, I think we do so on the basis of, say, the public interest and the wherewithal to do something today, and I think maybe that sister agency could criticize pollution control agencies in the same vein.

MR. LaVEILLE: They have.

MR. PURDY: And that public interest is such and the wherewithal to do something is much greater today than it was yesterday, and I do believe that the Soil Conservation Service, as it relates to the erosion control and increased or better farm practices on agricultural land, that they do have the expertise on how things should be done; they do have the communication with the farmer; that there are mechanisms in the Small Watershed Project -- for example, the Environmental Impact Statement -- that we, as pollution control agencies, can have some input to their programs; and that we need to encourage them to consider in their project those factors that we think are important.

MR. LaVEILLE: These points that you made are exactly the ones that we have taken into consideration in recognizing that we don't have the capability, the manpower, the information delivery systems, to get down to the farmers, the local level, where these erosion control or land management systems can best be implemented.

The EPA has, instead, chosen to try to work through memorandums of understanding with various U.S. Department of Agriculture agencies. There is in force now a memorandum of understanding with the Extension Service, which is the educational arm, through the universities, to initially -- the first impact would be to educate the farmers on careful, on safe pesticide control practices, now that some of the more longlasting pesticides, like DDT, are no longer available. So EPA is working through the Extension Service to try to get some of our efforts down to the local people that will use them. We are also, on a regional level, working with the Soil Conservation Service to try to get mutually directed programs. Some of their Soil Conservation Service programs are environmentally-oriented and some of our environmental programs are Soil Conservation Service-oriented to try to get coordination between the two agencies' goals and directions.

MR. PURDY: Thank you.

MR. MAYO: Any other questions, gentlemen?

MR. FRANGOS: Mr. Mayo, I would just follow up on Mr. Purdy's comments.

I sometimes get the feeling that the USDA and EPA are somewhat similar to the Army and Navy -- the discussion we had yesterday. I am not sure how much conversation goes on between the two agencies, at higher levels. I am encouraged at the last statement as to what is happening in the Region.

But I think we get the feeling that perhaps the agricultural community really isn't responding to the whole environmental thrust. That may not be the case. But I don't think this is being communicated to agencies and to the public as well as it might be.

I think if we look at the Council on Environmental Quality report, that its major recommendations were concerned about non-point pollution sources and problems.

If you look at the kind of investment that we are talking about -- assuming that legislation goes through -- at least some people are talking about $24 billion of investment in pollution control.

I think the obvious question is that we ought to look very closely at other pollution sources, if we are talking about making these kinds of investments.

I would support the several questions that have been raised in the committee report.

MR. MAYO: The point, I think, that ought to be made is that this is a committee report. There was participation from EPA and the four States, and I think there is at least the presumption that what is in the report reflects the sensitive situation of those who participated in its preparation. I am a little bit disturbed that we find ourselves in a dialogue this morning that appears to pit EPA versus the Department of Agriculture. I think it is a rather inappropriate view of the situation. EPA is not pitted against the Department of Agriculture, and I want to make that position clear.

Are there any other questions of Mr. LaVeille?

Thank you, Mr. LaVeille.

Gentlemen, in pursuing the Technical Committee report, the committee does have a series of items in its summary on page 17 that the conferees might want to have at least some measure of dialogue about; particularly important in that summary is Item 2, in the form of a recommendation, I suppose, that the maximum concentration of total phosphorus in municipal and industrial effluents be set at 1 mg/l. This would differ from the current conference report, I think, for 80 percent removal on a statewide basis, and this is perhaps an item that the conferees might want to have some commentary on in terms of the material that is in the Phosphorus Committee report.

Do you have a question, gentlemen? Did you want to pursue some of these questions at this time, or perhaps to have that kind of a commentary take place in the Executive Session?

MR. PURDY: I have one question that I would like to ask the fellow conferees, to see whether or not we are assessing the situation wrong in Michigan, or whether our situation there is somewhat unique, or if this is something that, in fact, exists throughout the four States that are involved in the Lake Michigan Enforcement Conference.

And the dollar figures that I use may not be the proper dollar figures, but I think the order of magnitude is the right relationship, and that is: as we look at the operating cost of an activated sludge treatment plant --

not debt retirement but operating cost -- and where, as a rule of thumb, this might be for a medium-sized plant in the neighborhood of $30 per million gallons of sewage treated, and then as you move into 80 percent phosphorus removal that you add an additional $30 to the operating expense, not including schedule time, so that we now have a total operating expense of about $60 per million gallons of sewage treated, and as we discuss this moving into 90 percent, that we add roughly 40 percent additional chemical cost, roughly another $12, or a total cost of $70 to $75 per million gallons of sewage treated, in the way of operating cost.

And although the polls show that environmental issues rank in first, second, or third priority of all of the issues that concern the public, that when municipal officials are called before our Commission and asked to put in phosphorus removal, this additional operating expense is something that they take on very reluctantly and sometimes only if by force. And that when they go back home and raise their rates to take care of this operating expense, it seems as though their customers on the system say, "Who, me? You have got to be kidding. Who is going to make a grant? Who is going to share in this operating cost?"

And now we are talking about going up to, say, a further increase, and I anticipate that this will receive the same reaction, and that as a pollution control agency that would attempt to bring about this program that I can see that we can only do it with difficulty with the present attitude of the people that must pay the bills.

I am wondering if my fellow administrators in the other States are experiencing that same problem, and if they anticipate that the only way that we can move from 80 to 90 percent removal is by extreme pressure placed upon the local units of government by that State agency and by EPA.

MR. MAYO: Mr. Currie.

MR. CURRIE: The standard which was proposed by the Technical Committee of 1 mg/l is the standard adopted by the Illinois Pollution Control Board on the basis of considerable hearings which demonstrated to us that phosphorus is perhaps the most serious problem in Lake Michigan, that it is deserving of the most urgent attention that we can give, that technology is available at reasonable cost for achieving that level. And on behalf of the Board, I would certainly urge that the conference approve this recommendation and that the other States adopt the regulation, as we have in Illinois.

MR. FRANGOS: A point of clarification. You say this applies for the Lake Michigan Basin, sir, is that your standing?

MR. CURRIE: Yes, that is right.

MR. FRANGOS: How many installations do you have?

MR. CURRIE: How many installations?

MR. FRANGOS: Yes, sir.

MR. CURRIE: Principally this means the North Shore Sanitary District and the Federal installations in that area.

MR. FRANGOS: Once that project inverts, Mr. Currie, will the Sanitary District be required to meet the 1 mg/l?

MR. CURRIE: They will not be discharging into Lake Michigan at all any more, so they will meet the standard by diverting out of the basin.

MR. FRANGOS: What will they be doing, sir? Where would that go? Where would the discharge end up? What kind of treatment will that portion receive?

MR. CURRIE: That will depend on the standard for the waters to which they discharge. In this case that would be largely the Des Plaines River and the Chicago River system which, according to the evidence presented to us, does not have the same kind of a phosphate problem. But for any discharge that is made or will be made to Lake Michigan or any other water that has a similar phosphorus problem, then we think there ought to be phosphorus removal to the 1 mg/l level.

MR. FRANGOS: But the North Shore Sanitary District and the people it serves will not be charged a cost -- whatever that may be, however you can identify it -- for the increment to get to 1 mg/l.

MR. BLASER: Yes, they will. Already this is being done at the Waukegan plant. The remaining plants will be doing this by December of this year, and they will continue to do so until these are diverted away from the lake.

Roughly this means that the people in the North Shore Sanitary District will be paying for the treatment at all plants that will shift over to the Clavey Road plant until 1974.

The Waukegan-North Chicago plant will continue to 1976, meeting the standard of 1 mg/l and paying for that standard.

MR. FRANGOS: Well, let me just discuss the situation as we view it in Wisconsin.

I think the point that Mr. Purdy perhaps raised is whether you can finance whatever this cost is going to be. It seems to me that the question that Mr. Purdy raises is: Ought you do it? And I think we would be inclined to look at the question as to whether it ought to be done. I think if we look at that question we automatically get into a cost-benefit consideration, which I assume is what the Illinois Pollution Control Board did.

Let me further add that at least the presentations that were made to this conference yesterday afternoon and this morning indicate two things: one, that indeed 1 mg/l effluent is being met throughout the country, and the information that I received doesn't give me the same degree of confidence that that report indicated.

For example, Milwaukee was cited as being able to achieve discharges down to concentrations of 0.5 mg/l, and in our conversations with the Metro people, they said that they could not absolutely guarantee that they could do this 365 days of the year. Beyond that, I think the impression is that this can be achieved by simply increasing chemical dosage, and I think you recognize this cost here as an important cost, but in some of our other facilities, we understand that you can dose as much as you want and you still aren't going to get it removed just by precipitation. Indeed, you may have to go to some kind of a filtration unit.

So, again, I think this is an important consideration in terms of the investments, operating costs, and a cost-benefit consideration.

If you look at the data that was presented to the conference on what is happening, you get a mixed scene certainly on the basis of two presentations that we had. And I would have to say, at this point in time, that we are not convinced that that incremental reduction is justified at this point in time.

MR. MAYO: Are there any other comments, gentlemen?

MR. McDONALD: Well, as the Federal conferee, I would like to make a comment.

I think for a number of years, the fate of Lake Michigan has been debated both from this forum and outside the forum. It has been a mixed bag in terms of fate of the lake. But it seems on the weight of all the evidence that is in, if a mistake is going to be made, it certainly is going to be made on the side of safety, and that is the simple solution. But maybe a simple solution is what is needed here.

We are not going to get the lake any better if we don't move now. We cannot correct the mistakes of the past if we don't move forward at the present time.

One of the staff members of the EPA did a little calculating on his own and, again, it is simple, but at $75 per million gallons that is a little less than a penny a day per capita. And a penny a day per capita, sitting in and of itself as an add-on cost for sewage treatment, seems to me is an expenditure that we cannot afford to not make.

Why are we doing this? Well, we are doing it to protect the lake. Results of increased nutrients in the lake are well known, have been catalogued to this conference and outside the conference in abundance. We have got several experts here who could recite this case again, and recite it specifically for Lake Michigan as to what will happen if the lake continues to get overenriched.

So, from a Federal standpoint, speaking as a Federal conferee, I think we ought to move on with the adoption of this requirement as rapidly as possible.

MR. MAYO: I would like to make a comment. I have been looking for an appropriate point to respond to one of the comments that Mr. Dustin made last night concerning EPA's posture as it relates to the control of phosphorus in detergents, and I think there has been a long dialogue on that.

In summary, briefly, as you recall, there was a commentary on the findings on the part of the Surgeon General expressing concern for the character and the hazards of the replacements for phosphorus filler in detergents. And a followup commentary on the part of EPA which, in effect, said that while there is no desire on the part of the Federal

Government, at this point in time -- and in a sense of purely justification on the part of the Federal Government at this time -- to establish a national policy for the control of phosphorus content in detergent, that those States or local governments that find themselves moving in that direction need to examine the alternatives very carefully for themselves, and take whatever measures they feel are appropriate to solve the eutrophication problems that are of significance to that State or to that community. At no point, to my knowledge, has EPA ever attempted to discourage a State or local government from moving ahead with those programs of phosphorus control in detergents which were felt to be necessary to take care of State and local problems.

So that, it seems to me, in the situation of Lake Michigan, with action already having been taken on the part of Indiana -- Michigan has constraints on the phosphorus content in detergents -- that the communities involved have available to them -- at least in those two States -- something other than treatment alone as the basis for reduction of phosphorus content in the municipal effluent, and that the reaching of a maximum concentration of 1 mg/l in the effluent may indeed be arrived at by a variety of actions.

But what this conference ought to address itself to is the reasonableness of the level of control of 1 mg/l, as has been recommended by the Phosphorus Committee, as being necessary for the control of water quality in Lake Michigan, and to leave to the community or to the groups of communities as they may relate to an individual State, the alternatives that are available to be used for arriving at that end result. And that the conferees, in my opinion, need to direct the weight of their decision toward the long-range water quality conditions in Lake Michigan, even though this might have a reasonably significant economic burden on the municipal and industrial waste dischargers. Then let's look at the weight of that requirement to give us the direction for improving the technology in reducing the cost,

MR. PURDY: Mr. Mayo, with respect to the 1 mg/l recommendation, if this conference determines that such a recommendation, in fact, is necessary to protect Lake Michigan, then I think it should be adopted and that we should do this.

In my discussion on the cost, though, we do see citizen interest here today and throughout this whole conference proceeding, and the conferees taking that sort of action that is determined necessary to protect the lake.

We do, in Michigan, see that same sort of citizen involvement in making sure that our Water Resources Commission takes that sort of action to require that the recommendations of this conference be required within the State.

Just one time though I would like to see an in-force, concerted citizen involvement before their own governing body saying: "Raise my water treatment rate so that we can treat the sewage to the level that the State and the conferees in this enforcement conference say is needed."

If this took place, I think we could accomplish our objective in half the time, particularly if the cost is largely that of chemical cost and does not involve State and Federal grant participation. And I just don't see that taking place. I don't see citizen involvement before their local body saying: "Raise my water rates. I am willing to take on 1-cent per day cost to have clean water in Lake Michigan." And I don't see that taking place.

MR. McDONALD: Well, I would have a brief answer to that, Mr. Purdy.

Admittedly, the cost of phosphorus removal for the most part is not going to be eligible for Federal or State grant participation.

On the other hand, the fact that you lament the fact that the citizens don't jump up to declare themselves in favor for higher expenditures, I think that your own State -- when you passed the $335 million bond issue -- the citizens were taxing themselves here. I think you passed that bond issue by -- is it 2 to 1?

MR. PURDY: Yes.

MR. McDONALD: You had a similar bond issue here -- the largest in the whole Nation, other than the bond issue passed by New York State -- the Illinois bond issue: $750 million. In fact, that was the second largest bond issue ever passed in the United States. New York State passed a billion dollar bond issue by an 83 to 17 percent margin. And other States have passed such bond issues. The people have voted directly on these bond issues, and I think they have demonstrated time and again that they are willing to pay for some of these solutions that have to be paid for.

Now, getting down into a local situation, when the mayors come in to your Commission -- and I have read your hearings time and again and I know the problems that you are confronted with over there -- he certainly doesn't want another $150 a day or another $300 a day. He just doesn't come in to volunteer for that type of expenditure if he keeps getting more taxes.

But it seems to me that the responsibility of this conference goes above and beyond the pressures that an individual mayor or a city council sitting back on a tributary stream in the State of Michigan, or any other State, may be confronted with, not realizing the overall benefits of what that expenditure is going for. And maybe we have failed in not demonstrating why these expenditures are needed, although I fail to see what else can be done to predict what will be the future of Lake Michigan if proper nutrient controls are not instituted.

MR. PURDY: Mr. McDonald, I agree with you. I am really asking for help: Continue the citizen interest in these conferences; continue the citizen interest in various State regulatory programs. But I am also now asking for their help in going back to their local community and making our job easier.

MR. McDONALD: Well, I think you know and I think I know, having been in this pollution business for some time, that that just doesn't happen. I doubt if anybody sitting in this room is going to go back and stand up before their city council and say: "You know what I heard in Chicago? It is going to cost you a penny per day more. I want you to agree with your State Commission that you ought to have this added expenditure."

It just doesn't seem to happen that way, and whether this is a popular decision locally or not, it seems to me that there is a responsibility here above and beyond that because this is what, I guess, they pay us for.

MR. PURDY: Yes. But this now means that when we consider the time necessary to implement this program it is going to seem like it takes an undue length of time --

MR. McDONALD: I know.

MR. PURDY: -- because we are going to have to kick everybody every step of the road.

MR. McDONALD: You are absolutely right. You know I am very interested in what happened in the State of Wisconsin in the last couple of months.

I think Tom Frangos, when he gave his report, showed the very dramatic turnabout from the information that was available to us in August, where he had a real number of delinquent communities that were not going to meet the phosphorus control deadline for the end of 1972. And he came into this conference and that was dramatically turned around and you heard him from the podium yesterday.

Why did this happen? He said he thought it happened because of the State and the Federal pressure that would result in making these communities realize that these agencies finally mean business. And I think that fact was probably the instrumental fact, according to Mr. Frangos. Maybe we need to be stronger in terms of"we mean business to get this job done."

MR. SCHRAUFNAGEL: I believe that we in Wisconsin have some reservations in the observance of the law, and that is the actual feasibility of maintaining the 1 mg/l at all of our installations.

As part of the engineering that goes into these processes, we recommend that they do some pilot work. A number of them -- or practically all of them -- do this pilot work, and in some of those communities, in their consultants' opinion, they cannot reach the 1 mg/l regardless of the amount of chemical that is added.

True, the city of Milwaukee and the Metropolitan Sewerage Commission has its own pilot plant and gets concentrations down to 0.5 mg/l. But even at this installation, if we asked the operators whether they can do it, whether they can guarantee it every day, the answer is "No." They could guarantee it at that installation perhaps on a monthly average or a yearly average, but to guarantee it every day, no.

At other installations, where they have peculiar type wastes, they claim they cannot reach the 1 mg/l level, and I think this was also brought out to a certain extent by Dr. Barth yesterday. He cited some plants that were getting 1.2 or 1.3 or 1.4, in addition to those that were getting less than 1 mg/l.

MR. McDONALD: I -- excuse me.

MR. BLASER: May I add something from Illinois?

MR. McDONALD: Let me just add that one statement.

I think that that point that Mr. Schraufnagel raises is a very good point, that maybe this 1 mg/l cannot be demonstrated at every single plant, and maybe not at the majority of the plants. But the issue that the conference and that the conferees are faced with is whether we ought to shoot for this as a goal, if nothing else.

It seems to me, again, if it cannot be reached from a technical standpoint consistently, that is something that we have to do ongoing work on while, at the same time, trying to reach this 1 mg/l as consistently as possible.

I cannot imagine anyone in the Federal or the State regulatory agencies going after a community that failed to meet the conference requirement or goal because it was technically impossible to achieve that goal.

MR. MAYO: A point that seems to be of some concern to you gentlemen is the 24-hour composite sample requirement in the committee's recommendation.

Would it be reasonable to look at this from the standpoint of an accounting for the 1 mg/l average on other than a daily basis; look at it from a weekly basis or a monthly average basis, to provide for the vagaries of operation, the opportunities for periodic or short period upsets that might take place in any sewage treatment plant, and yet accomplish the intent of the recommendation by having that level of constraints accounted for on a longer period of time?

MR. BLASER: Mr. Chairman.

In listening to each of these points that is being debated currently, that we have taken care of in Illinois -- there are not new issues.

Most people are aware that the Illinois standard-setting procedure requires that formal public enforcement hearings are held before the Pollution Control Board, and that each element is debated openly and subject to cross-examination. This was done on each of the questions that are being discussed right now: the question of technical feasibility; the question of cost; the question of need, as far as Lake Michigan is concerned; the question of banning detergents on a statewide basis, and so on.

If it would be of any value to the conferees, I could get photocopies of the Board's opinion, which summarizes each of these points in some detail; and then further if there is need to, it refers to the explicit testimony in the record. I could have such copies here by this afternoon if this would be of any help. (The document follows.)

And incidentally, Illinois, after all that evidence, decided that it was technically feasible, that the costs were reasonable, that the need was present in the lake,

ILLINOIS POLLUTION CONTROL BOARD
April 28, 1971

in re)
PHOSPHORUS WATER STANDARDS) #R70-6

Opinion of the Board (by Mr. Dumelle):

1. Introduction

We like to believe that there is a time and place for everything. The time to be serious about saving our place called Lake Michigan is very quickly passing. It has been demonstrated to the Pollution Control Board that we must enact measures which will restrict the input of phosphates into the Lake now so that it will not suffer the fate of Lake Erie, so that Lake Michigan will not have its quality impaired beyond the present state, so that Lake Michigan will not be lost as a "great" lake. To preserve Lake Michigan as a source of public water supply, as a commercial and sport fishing center, as an invaluable recreation area and as a natural public possession of inestimable worth we must act now.

The first annual report of the President's Council on Environmental Quality recommends that a concerted and comprehensive attack be made on eutrophication. The report stresses three necessary actions: 1)phase phosphates out of detergents as soon as feasible, 2)find better methods to control agricultural runoff, and 3) remove from lakes more of the nutrients generated by towns and cities particularly in urban centers and critical areas such as the Great Lakes (R. 489).

With the enactment of the Environmental Protection Act, the Illinois Legislature charged the Illinois Pollution Control Board to "determine, define and implement the environmental control standards" necessary to accomplish the purpose of the Act -- "to restore, protect, and enhance the quality of the environment..." [Sec. 5(b), 2(b)]. The enactment of a water quality and effluent standard to restrict phosphorus discharges into Lake Michigan is a measure backed by that purpose.

Possibly the single most urgent concern we must have with Lake Michigan is the question of accelerated eutrophication -- that is, concern with the speed-up of the natural aging of the Lake due to man's introduction of an abundance of nutrients in a quantity fantastically beyond nature's input. As a rough but dramatic analogy we can view nature's input of nutrients into Lake Michigan as being enough to feed a suckling piglet while man's activities, including agriculture, are pouring in a sufficient amount to sate a 500 pound hog. With final adoption of the phosphate water quality and water effluent standard on January 6, 1971, the Illinois Pollution Control Board has in effect declared that "We must save Lake Michigan - no ifs, ands or buts - starting right now".

The section of this opinion headed Eutrophication has been further subdivided to consider the following questions:

a. What is the present lake quality?
b. Why limit phosphorus?
c. At what level should phosphorus be limited?
d. What is the contribution of land-runoff?
e. Should phosphate detergents be banned?

2. Effluent and Water Quality Standard

The phosphorus standard adopted by the Board on January 6, 1971 originally proposed on August 19, 1970 in a somewhat different form. As finally enacted this standard reads as follows:

PREAMBLE

Phosphorus is an element which is a nutrient for algae. Present Federal and State policies for Lake Michigan include the control and reduction of phosphorus in order to limit the production of algae. Algae causes tastes and odors in water supplies and may reduce dissolved oxygen in water. Algae is a nuisance to swimmers and can reduce the enjoyment and property values of shore line property.

The present standards for phosphorus in the water of Lake Michigan are at levels which are thought to be those at which algae blooms will occur and greater than present bulk water levels. The new standard is 2/3 of the former standard. An effluent standard is added to provide a control on phosphorus discharges to Lake Michigan.

1. Water Quality Standard. Existing Board Regulations specifying water quality standards for Lake Michigan, Wolf Lake and the Calumet River (lakeward of the O'Brien Locks) are hereby amended to provide that the concentration of total phosphorus measured on unfiltered samples in these waters shall not exceed 0.02 mg/l as phosphate (PO_4) or 0.007 mg/l as phosphorus (P).

2. Effluent Standard. Except for unavoidable combined sewer overflows during the interim period before their complete elimination, no effluent to the waters of Illinois listed in Section 1 above, shall include phsophorus in excess of 3.0 mg/l as phosphate (PO_4) or 1.0 mg/l as phosphorus (P) after December 31, 1971. Dilution of effluents shall not be acceptable alternatives to treatment. Where water is added to streams of waste water and cannot be reasonably separated, then its quantity shall be measured and effluent concentrations recomputed to exclude its diluting effect.

3. Testing. All testing pursuant to the Regulations herein provided shall be made using methods as listed in the publication "Methods of Chemical Analysis of Water and Wastes", November, 1969 as issued by the U.S. Federal Water Quality Administration.

4. Effective date. Except as specifically provided in Section 2 of these Regulations, the requirements of these Regulations shall be met within ten days after filing with the Secretary of State.

3. Eutrophication

The pollution problem or hazard presented by the introduction of phosphates into water bodies, and in this case Lake Michigan, is the enhancement or increased rate of eutrophication. Leading authorities, including Dr. A.F. Bartsch have stated that the problem of eutrophication is one of the chief concerns about Lake Michigan. Eutrophication is the aging process of the Lake in which the waters become more fertile and acquire a greater ability to grow algae and other forms of unwanted living matter. Eutrophication becomes a severe problem when the algae become so preponderant that they color the water green and interfere in many ways with the continued usefulness of the water. Considering the undesirable effects of eutrophication, it may be regarded as a severe form of pollution.

Human sewage and industrial waste are significant sources of nutrients that contribute to the eutrophication of Lake Michigan. Drainage from farm land is also an important source, a substantial quantity of the nutrients come from manure that is spread on frozen grounds which is subsequently flushed into streams during spring thaws and rains. Runoff from urban areas is rich in phosphate and nitrate. (Ex. 3, p. 4)

The abundance and species composition of planktonic, bacterial, benthic and fish populations change as eutrophication progresses and changes of this nature may be used to detect and measure the degree and rate of eutrophication. Enriched lakes develop dense populations of planktonic algae, commonly dominated by a few species of blue-green algae. Lake Erie has already experienced the elimination of benthic invertebrates and massive blue-green algae blooms. (Ex. 3, p. 4)

Dr. Bartsch has stated that some of the changes to look for are: decrease in transparency of the water; increase of total dissolved solids; loss of dissolved oxygen in the deeper layers; and changes in bottom dwelling animals and microscopic plants. When eutrophication has not proceeded to an obvious and objectionable stage, it becomes necessary to examine the combination of these more subtle clues in order to sense the existing state of affairs. In many cases, such scrutiny may reveal a forecast of things to come. Changes such as the above are now appearing in Lake Michigan (R. 69).

a. What is the present lake quality?

The testimony of Dr. Bartsch showed that extensive inshore areas of pollution were found along the entire southern perimeter of Lake Michigan. At various times swimming beaches have been closed in Chicago and other areas when large mats of foul smelling algae have been deposited on the beaches. The aesthetic character of Lake Michigan has been impared by algae on many occasions. On a far more practical level drinking water treatment plants have had their operation and efficiency impaired by short filter runs and tastes and odors resulting from high phytoplankton. Such impediments to the operation of these plants have lead to increased cost of water treatment in Chicago and other cities (R. 24).

High concentrations of phosphorus favor the blue-green algae which are capable of using nitrogen from the atmosphere as a source of nutrition. These algae are particularly obnoxious because they are more buoyant than other forms thus tending to form windrows and produce especially obnoxious "pig pen odors" because of chemical compounds peculiar to them. The seemingly inexhaustible supply of algae that has washed ashpre in recent years has defied maintenance attempts to keep some beaches usable during the entire recreational period. Bathers and sunbathers must travel further to enjoy their sport (R. 27).

Bottom animals serve as a vital link in the aquatic food web by converting plant food into animal food for predatory fishes. Changes in numbers and species of bottom animals consisting predominately of burrowing worms favors a community of fishes such as carp and suckers that root for their food. An increase in worms is a product of an increased food supply from sedimentation or organic waste materials or dead algae. Changes in the kinds and numbers of bottom animals are effects that are frequently a product of pollutants; these changes result in damages to desirable aquatic organisms, and may produce increased numbers of undesirable aquatic organisms that interfere with the use that can be made of the water (R.29).

Mid-Lake Area

Deep water areas of Lake Michigan are as yet unaffected by the more intensive pollution observed in many in-shore areas. The soluble phosphate content has been determined to be 0.02 mg/l (PO_4) in deep water areas as an average with some concentrations going up as high as 0.14 mg/l. Areas close to shore averaged 0.04 mg/l with some concentrations as high as 5.00 mg/l.

In-Shore Area

Inshore areas are primarily the shoreline areas which are used for recreation, which extend out as far as one goes for water supply. This may be out to a depth of approximately 10 meters or approximately 40 feet (R. 93).

Massive areas along the perimeter of the southern half of Lake Michigan are polluted to such an extent that large populations of pollution tolerant sludgeworms occur (R. 36). For several years the Chicago Park District has reported that beaches became fouled with algae washed in from the Lake. The windrows of algae that completely lined the beaches became foul smelling after a few days exposure to the summer heat. Flies and other insects covered the decaying mass (R. 46). These biological findings reflect the deteriorated water quality of Lake Michigan and represent the gross pollution resulting from the domestic and industrial waste discharged into the Lake and the result of urban and rural land runoff of nutrients (R. 50).

The facts revealed by these studies make up the story of what has been happening to Lake Michigan in recent times. Many aspects of the story are far from clear but what is clear is that excessive amounts of nutrients are present (R. 67).

In the words of Dr. Bartsch the condition of Lake Michigan can be summarized as follows:

> The tremendous mass of data gathered on the physical, chemical, and biological status of Lake Michigan indicate that the Lake, as a whole, is beginning to show some early symptoms of accelerated eutrophication.
>
> The offshore, deep water areas of Lake Michigan do not show substantial effects of pollution or the onset of eutrophication forces. They do, however, exhibit a combination of minor and subtle changes that suggest that the real beginnings of eutrophication are just around the corner.
>
> In contrast to the offshore waters, the inshore areas have changed drastically ... In recent years both attached and free floating algae, ... frequently have appeared in nuisance proportions at various harbour and waterfront areas around the Lake.
>
> The growth of such masses of algae is a direct response to concentrated levels of nutrients brought into the Lake by way of municipal sewage, land runoff, urban drainage, industrial waste and other sources. In Lake Erie growths of [algae] seem to have been aforerunner of the more widely dispersed free floating or plankton growths that now exist there.
>
> In the southern end of the Lake there is ample evidence of deterioration of chemical water quality in areas adjacent to population centers. Total inorganic nitrogen and soluble phosphate were found to be highest here (R. 79-83).

Dr. Bartsch concluded as follows:

> While the deep water areas of Lake Michigan give only a suggestion of creeping eutrophication, the Lake's response to increasing nutrients in the inshore waters is obvious and shows that the Lake can respond when nutrients for plant growth are abundant. Lake Michigan, as a whole, is now at an early stage in the eutrophication process that was passed through by Lake Erie at some point in the past. With increasing time, nutrient levels will increase until finally the entire Lake becomes involved. With certain reservations, Lake Erie can be viewed as a prototype and a preview of what can happen in Lake Michigan if nutrient bearing wastes input continues unabated (R. 87).

b. Why limit Phosphorus?

Many nutrients are required for the growing of algae and among these are carbon and phosphorus, nitrogen and others. The easiest one to limit is phosphorus. The activities of people account for a high proportion of the phosphorus input into troubled lakes. This is a good reason to focus control on phosphorus.

Dr. Bartsch commented on carbon as a limiting factor. He stated that briefly, the carbon theory is that if bacteria in the Lake which have the capability of decomposing organic matter, in doing so liberate carbon as carbon dioxide, then the supply of carbon dioxide in the water is increased and is available to algae for growth. Obviously this accelerates the eutrophication process. The carbon theory implicates carbon as the culprit and attaches little significance to phosphorus input. An important tenet of the theory that carbon is the critical factor in the process of eutrophication is the symbiotic relationship between bacteria and algae; the relationship is the main thesis of the Lange-Kuentzel-Kerr proposition. Dr. Bartsch stated that he disagrees with this thesis and feels that the principal scientific and limnological community is also in disagreement with the thesis. The fundamental biology relating to algae, an abundance of which signifies the most onerous characteristic of eutrophication, requires that a number of nutrient elements are necessary to support their growth. Algae use up carbon in a ratio of 100 to 16 nitrogen to 1 phosphorus atom.

Also to be considered is the fact that carbon and nitrogen are very nearly ubiquitous while the same cannot be said for phosphorus. That is, phosphorus can be kept out of the water more easily than can either carbon or nitrogen. Lakes that have been studied and seem to indicate that carbon may become the limiting factor are not typical lakes, the kind generally thought of with eutrophication problems. A more in-depth look at the question leads one to the conclusion that for all practical purposes the controlling element to consider is phosphorus (R. 278).

Some lakes with high phosphorus content are not algae bloomers because other elements, sometimes trace metals, are not present. In Lake Tahoe nitrogen may be the limiting factor (R. 314).

To ascertain the limiting factors one must look at all the nutrients that are needed. If one of the nutrients, phosphorus, can be limited, then it becomes the critical limiting factor. We do not know with complete certainty what the limiting factor in Lake Michigan is (R. 286). But it is manifestly evident that phosphate has an effect on the algae population in Lake Michigan.

c. At what level should phosphorus be limited?

The generally accepted rule of phosphate in excess of 0.01 mg/l as P as causing algae blooms appears to have been derived from a paper published in 1947 by Clair N. Sawyer (Ex. 2). Before undertaking any discussion of eutrophication and phosphate input into water it should be noted that considerable confusion inevitably arises as to whether one is expressing concentrations and inputs in terms of phosphate (PO_4) or phosphorus (P). Fortuitously the conversion factor from phosphorus to phosphate is simply 3. Conversely to change basis from phosphate to phosphorus is simply a matter of dividing by 3. In this opinion the convention of expressing concentration on the phosphorus basis is used unless otherwise noted.

If the availability of phosphorus is increased, algal growth increases. Sawyer (Ex. 2) has demonstrated this although his data has been misused. Sawyer stated that if the studied lakes were to have a concentration of inorganic phosphorus at the level of .015 mg/l at the time of the spring overturn and an accompanying concentration of 0.3 mg/l of nitrogen objectionable blooms of algae would result. Some observers have ignored the spring overturn and others have interpreted these numbers to be somehow magic below which there would be no algae and above which there would be an abundance.

Mr. John Morris of the City of Chicago, Department of Environmental Control recommended the setting of a water quality standard lower than .02 mg/l (PO_4). He stated that the proposed effluent standard of 1 mg/l (P) does not appear to be adequate to protect Lake Michigan from the threat of accelerated eutrophication due to the presence of excessive amounts of phosphorus. It does not appear to reflect the more stringent standards being considered elsewhere nor the potential of current technology. He urged the Board to adopt an effluent standard which recognizes and requires utilization of the best available technology (R. 492).

The Lake Michigan and Adjoining Land Study Commission has stated that the Lake should not be allowed to deteriorate beyond its present phosphate level (R. 349). The Commission asserted that if the proposed effluent standard, 1.0 mg/l as P, were adopted and if current sources of phosphate input were allowed to continue discharging at their present rates water quality would deteriorate. The Commission urged the Board to arrive at a standard which would not further degrade the Lake. Phosphorus removal technology is available for use today the Commission asserted, and an effluent standard of 1 mg/l will still degrade the Lake.

It must be stated that the effluent standard of 1 mg/l (as P) was not designed to meet the 0.007 mg/l water quality standard because, as was stated in the original proposal, there was no way of ascertaining that figure (R. 359). The figure of 1 mg/l was proposed as representing the application of the maximum feasible technology for phosphorus removal.

Phosphorus removal technology is both well known and readily available. Phosphorus removal can be effected by either straight biological removal, straight chemical precipitation or combined biological-chemical removal. Other, less common processes such as ion exchange, and electrodialysis are less feasible, but available. Removal efficiencies in the range of 80-05 per cent can be expected from the ordinary treatment methods. (R. 185-186).

The treatment method which can most easily be designed, constructed and operated today is chemical removal by precipitation and coagulation. The chemical removal process can be closely controlled and efficiencies in excess of 90 per cent are readily effected. (R. 190-192). An additional benefit accrues in the removal process inasmuch as other pollutants are substantially reduced. Lime, alum, polyelectrolytes and waste pickle liquor are the most common chemical additives in use today. All four treatment methods are straight-forward, reliable and easily controlled to produce a predictable effluent quality. The choice of which chemical agent to use is principally dictated by local considerations such as availability of pickle liquor and sludge disposal requirements.

Mr. Raymond E. Anderson, General Manager of the North Shore Sanitary District discussed the District's experience in using waste pickle liquor (spent hydrochloric and sulfuric acid) which is trucked from a steel works in Waukegan to the Waukegan treatment plant. The chemical is available at no cost, other than freight costs, to the District; the steel mill is happy to be rid of it as it alleviates a waste disposal problem for the mill. Eighty percent removal of the 12-15 ppm of phosphate in the plant influent is accomplished by addition to the sedimentation tanks (R. 122-127).

Costs of phosphorus removal have been variously estimated. At one end of the spectrum is the minimal capital and chemical use and operating costs associated with the use of spent pickle liquor. Dr. John Pfeffer, Professor of Sanitary Engineering at the University of Illinois, testified that technology is available for removal of phosphorus at the 90 percent level at the cost of less than 5¢ per 1,000 gallons (R. 164-165). He further testified that treatment with polyelectrolytes or lime are probably at the same cost level (R. 182). As processes improve, the record of experience is lengthened, and economies of scale are realized, it is anticipated that treatment costs will be much improved (R. 194-196). On another basis it was estimated that removal of 50% of the phosphorus in sewage could be accomplished at a cost in the range of $.22 to $1.40 per person per year (R. 405, 419-422).

The analytical method of determining the phosphate content of waste water and Lake Michigan water was another subject of consideration for the Board. To facilitate the comparison of data from an historical prospective, it is important that reports from various years can easily be correlated. The Illinois Sanitary Water Board's report of May 1970 indicated a change in analytical technique as follows:

> During 1968...the tests were performed on unfiltered samples. It was decided prior to the 1969 season that only soluble phosphates should be measured. Therefore the 1969 samples were all filtered prior to analysis.

Such a change in laboratory methods can, and indeed has, resulted in data which cannot be easily compared. The Board therefore felt that the method or a choice of methods should be specified in the standard.

Other testimony indicated that the ratio of total phosphorus to that form of phosphorus available for plant growth varies widely and it is therefore desirable to establish limits on the total phosphorus rather than on that part of the element that may be available for immediate plant use. The appropriate phosphorus determination for water in which there is a substantial amount of suspended soil particles is currently receiving further study. For Lake Michigan the record shows that the standard should apply to total phosphorus and not simply a portion of the phosphorus such as soluble or filterable phosphorus.

d. What is the contribution of land runoff?

One of the principal factors that affects the rate of eutrophication is the extent to which nutrients needed by algae enter the body of water. Under natural conditions unaffected by man, the input of nutrients from the watershed runoff, and in deposition from rain and snow is low. The aging process thus proceeds at a low rate. Cultural developments on the watershed such as the establishment of cities and various agricultural activities accelerate the nutrient input leading to accelerated aging (R. 71). The Lake is brought more rapidly to a high level of fertility, and greater crops of algae and other plants are produced than under natural influences alone (R. 73).

Drainage areas that are primarily rural with intensive agricultural activities can be expected to have runoff as the major phosphorus input; as the land use changes from agricultural to urban, the contribution of phosphorus from land drainage decreases (R. 155-157). In heavily urbanized drainage basins a major portion of the phosphorus originates from waste water from municipalities and industry. The FWQA study of Lake Erie indicated that approximately 2/3 of the phosphorus input into Lake Erie was attributable to urban sources. Clearly, control of municipal and industrial discharges to Lake Erie would markedly reduce the eutrophication effects. It must be noted that the Lake Erie basin is very small and highly urbanized and in this regard contrasts strikingly with the Lake Michigan basin (R. 157).

Dr. Bartsch estimated that the annual input of phosphate to the Lake from the soils of the Lake Michigan basin amount to approximately 5,000,000 pounds per year. Another 10,000,000 pounds comes from municipal and industrial waste (R. 74). Expressed as phosphorus this would be a total annual input of 5 million pounds. Although this estimate of phosphorus input is frequently heard, it is open to question and is currently undergoing re-evaluation. The sources of the phosphate can be readily identified but quantification of the phosphate input from each source is not easily made.

Mr. R. H. Harmeson reported that the annual phosphorus input to Lake Michigan in 1963-1964 totaled 4,790,000 pounds while the outflow was 262,000 pounds. The total input was estimated to be about 1/3 (1,640,000 pounds) from soil in runoff and 2/3 (3,150,000 pounds) from municipal and industrial wastes. The population for 1960 in the Lake Michigan drainage basin was 4.2 million. This excludes the large numbers of people living in the Chicago metropolitan area complex since they are outside the Lake drainage area. The reported phosphorus input calculates to a phosphorus input rate of about 0.7 pounds per person per year from the domestic-industrial source.

Using Harmeson's 1963-64 input data the extrapolated estimate for 1970 is 5,650,000 pounds of phosphorus input into Lake Michigan. Of this total 1.6 million pounds is estimated as soil runoff and 3.9 million pounds as contained in waste effluents and a comparatively miniscule 150,000 pounds as direct precipitation contained in rain and snow. These figures are the result of using an estimated annual usage rate per person of 0.7 pounds as phosphorus.

Harmeson stated that the 1964 estimate for the input rate from land runoff was 36 lbs./mi.^{2}/year which he characterized as a highly conservative rate. Sawyer's average for the Madison Wisconsin area was 255 lbs./mi.^{2}/year (R. 331-332).

The accuracy of these estimates of input rates is not nearly so significant as the relative magnitude of the contributions from various sources, the phosphorus input from waste effluent compared to that from land runoff is a ratio of 2:1.

Mr. Harmeson also reported estimated phosphorus loading using a more realistic input estimate of 4.0 pounds/person/year. With this latter rate the 1970 input estimate totals 23.75 million pounds with the soil runoff remaining the same at 1.6 million pounds and the amount attributable to waste effluents being 22.0 million pounds (R. 335).

It is interesting to note that using Sawyer's estimate of 255 lbs./mi.^{2}/year for the land runoff figure results in a total loading from this source of 11. 68 million pounds per year. When juxtaposed with Harmeson's estimate of 22.0 million pounds of phosphorus from industrial-domestic sources the ratio of 2:1 is maintained.

A very recent analysis by Mr. Michael J. Schmitt (Phosphorus and Phosphorus Input to Lake Michigan, unpublished manuscript, 1971) reports a 1969 total input level of 15,282,222 pounds/year as phosphorus. This is more than 300% greater than the input figure usually heard. No attempt is made to estimate the important ratio of waste effluents to land runoff. The great disparity in the various estimates of phosphorus inputs is a lustily waving warning flag to all investigators pointing to the fact that more definitive investigation is needed to more precisely ascertain both the actual amount of input and the relative contributions of waste discharges and land runoff.

The disparity in the estimates also suggests that the contribution attributed to land runoff may be grossly understated and that indeed runoff may be the greatest contribution. This has been suggested to the Lake Michigan Enforcement Conference with the further suggestion that the Conference undertake an immediate comprehensive survey of the question.

e. Should phosphate detergents be banned?

The amount of phosphates discharged to Lake Michigan are partly controllable and partly uncontrollable. If phosphates in treated waste water are to be controlled, two methods are available; (1) elimination at the source or (2) removal in the treatment plant process. Waste detergents are a principal source of phosphates in sewage. Steps have been taken locally and are being considered nationally to ban the sale of detergents containing phosphates (R. 120).

Mr. John Morris of the City of Chicago Department of Environmental Control requested that the Board consider regulations prohibiting the sale of detergents containing phosphates. He introduced as an exhibit a copy of the Chicago ordinance banning the sale of detergents containing greater than 8.7% (wt. % expressed as P) of phosphates after February 1, 1971 (R. 492).

Mr. Theodore Brenner testified as a witness for the Soap and Detergent Industry Association and Dr. Paul Derr testified for FMC Corporation as a major producer of phosphates for detergents. The Soap and Detergent Industry Association is an industry trade organization representing well over 90% of the soap and detergent production in the country. Mr. Brenner stated that the Association is fully in support of any effort to control nutrient inputs into lakes and other surface waters which may be endangered by accelerated cultural eutrophication. He stated that, where feasible all wastes should be diverted from lakes and where diversion of waste water is not possible improved waste technology should be applied.

Mr. Brenner reported that the detergent industry has accelerated its research efforts in the search for a phosphate replacement. The program has first priority in several company laboratories. He further stated that the most widely discussed phosphate replacement material, NTA (nitrilotriacetate), has a primary value in combination with phosphate in detergents. There are other problems with NTA at the present time. NTA has not been thoroughly tested as to its ultimate environmental safety and there are indications that widespread use of NTA may have a more adverse effect on our environment then use of phosphates.(R. 406). Polycarboxylates were noted as another class of materials attracting attention for detergent use although these materials may not have the proper performance characteristics and they may not meet the necessary biodegradability standards (R. 407). Still other materials which are talked about as a replacement for phosphates in detergents are various forms of silicates. Sodium carbonates are also being considered (R. 416).

Why not a return to soap? It was stated that this appears to be impractical because (1)the supply of fats and oils is inadequate to furnish the needed raw materials, and (2)the performance of soap in modern automatic washing machines is not on the same level as detergents. The first synthetic detergent was marketed in 1934, it contained no phosphate and was a failure.. Following World War II phosphates and detergents were combined and from that point they enjoyed a dramatic growth to the point that by the early '50's, soap was virtually off the market place (R. 412). Phosphates are unique in that they perform several functions in detergent products and there is no single replacement material. They soften water, they are anti-redeposition agents, they emulsify oils, and they adjust alkalinity. The phosphate portion of the detergent is an extremely important part of the product (R. 431).

Although in considering the phosphate problem, the Board initially proposed only a water quality and effluent standard, the Board made clear during the hearing that matters such as a ban on phosphate containing detergents was another avenue which could and should be considered. The fact that the State of Illinois has a very limited number of phosphate dischargers into Lake Michigan was an important consideration in considering a phosphate detergent ban. The phosphate discharges to Lake Michigan from Illinois are limited, being confined almost exclusively to the discharges from the North Shore Sanitary District. The Sanitary District is presently experimenting with the use of waste pickle liquor from a steel company for phosphate removal in its waste water (R. 122). Results of full plant scale application indicates phosphate reductions on the order of 80% to be readily attainable. It appears that the use of pickle liquor may be the answer to the North Shore Sanitary District meeting the phosphate removal requirements. Further, the North Shore Sanitary District has plans to divert away from Lake Michigan by early 1973. At that time most of the phosphate into Lake Michigan will be coming from Indiana, Wisconsin and Michigan (R. 360).

Dr. Bartsch stated that consideration should be given to banning phosphates in detergents. Curtailing the input from all sources and not only of all of the sources of waste which are treated should be the rationale. Inputs of phosphorus are additive in terms of the various sources that are involved. As regards qualifications to the banning of phosphates from detergents, Dr. Bartsch said that we would not want to replace it with an element or a compound or a substance which has a substantial deleterious effect on the environment like phosphates.

There is no question that the Board has the power to outlaw the sale or use of phosphate detergents under Section 13 of the Environmental Protection Act. Because the Board has decided not to impose a ban on phosphate detergents with this regulation does not mean that it will not do so at another time. The Board presently has before it a citizen's petition pursuant to section 28 of the Environmental Protection Act which seeks to ban the sale of all detergents or other cleaning products containing phosphorus throughout the entire state after June 1, 1972.

4. Summary and Conclusion

Perhaps the most succinct and cogent statement of the rationale underlying the adoption of the water quality and effluent standard for phosphate is the explanatory statement which accompanied the original proposal:

> Phosphorus is an element which has been implicated in the excessive growth of algae in fresh water lakes. The algae grows, dies and in decomposing robs the water of necessary dissolved oxygen. In addition, algae is a nuisance on beaches to swimmers and to water treatment plants.
>
> The proposed water quality standard for phosphorus is 2/3 of the present standard and is at the same level as the bulk waters of Lake Michigan. Since the existing phosphorus water quality standard is not at the danger level for algae blooms, it is prudent to tighten this standard.

The consideration of a phosphorus limitation of input into Lake Michigan was one of the first matters considered by this new governmental agency, the Illinois Pollution Control Board. The urgency attached to this matter was not misplaced. To prevent

Lake Michigan from becoming another Lake Erie, to preserve our beautiful Lake, we must take this action now bv restoring the inshore areas of Lake Michigan to an acceptable state and preserving the offshore waters in their present state of purity. We must keep all nutrient input from all sources at the lowest possible level consistent with feasibility and reasonableness.

The offshore waters of Lake Michigan are now of high quality. They are just beginning to show slight, subtle changes in the direction of eutrophication. Localized inshore waters are now eutrophic and have lost their usefulness for many desirable purposes. If forecast of future chemical input materializes, eutrophication processes will be accelerated. Problems in inshore areas will then become even more distasteful and costly and they will gradually involve the offshore waters. Accelerated eutrophication can be prevented if actions to slow down nutrients input are taken soon enough. The Lake Michigan campaign can be largely a preventive one. Therefore, more effective and economical than a totally restorative program. All controllable nutrient input should be stopped (R. 91).

To save our lake, to preserve its present quality from further deterioration we must rein-in the present galloping eutrophication in the near-shore areas. Ample testimony has been presented before the Board which emphasized that the most feasible way of doing this at this time is to limit the input to the Lake of the essential nutrient, phosphorus.

Dr. Bartsch in stressing the importance of keeping nutrients out of the lake put it this way:

> If you like this Lake the way it is, then you ought to quit insulting it with all this junk you are putting in; and if you keep the level down to the lowest you can, maybe you can even turn it back in time (R. 305).

I concur:

David P. Currie

I dissent:

I, Regina E. Ryan, Clerk of the Illinois Pollution Control Board, certif that the Board adopted the above opinion this 28 day of April, 1971.

Regina E. Ryan, Clerk
Illinois Pollution Control Board

ILLINOIS POLLUTION CONTROL BOARD

April 14, 1971

PHOSPHATE WATER STANDARDS

Supplemental opinion (Samuel R. Aldrich, Board Member)

There are a few sections of the opinion with which I do not concur.

Page 1. Rate of phosphorus inputs

The opinion states that man's activities including agriculture have greatly increased nutrient additions to the lake. This is not supported by studies by the Illinois State Geological Survey of bottom sediments in southern Lake Michigan. The top 1 inch or less of bottom deposits averages no higher in phosphorus than the layer immediately below or of several other more deeply buried layers representing deposits many thousands of years old. If the sewage from Chicago were being discharged into Lake Michigan, which it is not, the phosphorus input would be very large indeed.

It is my opinion that, with the possible exception of increased animal wastes, the introduction of agriculture has had little effect on the phosphorus available for accelerated eutrophication. When grass, leaves, and weeds are left entirely on the surface as in the virgin condition, soluble organic phosphorus compounds resulting from decay are more likely to be carried off into surface waters than when crop residues are incorporated into the soil through farming practices. I feel that this explains the unexpected concentrations of phosphorus in bottom sediments previously described.

Page 9. The proper method for determining phosphorus in water.

The opinion states that total rather than filterable phosphorus is the proper method to assess potential for eutrophication. I agree that this is the correct method for Lake Michigan. Filterable phosphorus by itself fails to measure the phosphorus that is temporarily bound within the tissues of living and dead organisms including higher plants that are in suspension and thus included in the water sample. There is, of course, an additional reserve in the form of dead plant residues and phosphorus loosely held in bottom deposits.

Total phosphorus is not a suitable measurement on the streams of Illinois in which there is an appreciable amount of suspended soil particles. Much of the phosphorus that is associated with soil particles is unavailable or only very slowly released into water. Although this subject urgently needs additional research, it appears likely that a given amount of phosphorus attached to soil particles will support only 1/4 to 1/7 as much algal biomass growth as the same amount of phosphorus in soluble phosphorus compounds (R. M. Gerhold and J. E. Thompson, 1969).

Several soil scientists who are authorities on phosphate chemistry suggest that soil sediment-associated phosphorus is 10 to 30 percent as available for supporting eutrophication as phosphorus in solution.

Samuel R. Aldrich

Samuel R. Aldrich
Member, Illinois Pollution Control Board

I, Regina E. Ryan, Clerk of the Illinois Pollution Control Board certify that Dr. Samuel R. Aldrich submitted the above opinion on 14 of April 1971.

Regina E. Ryan
Clerk, Illinois Pollution Control Board

and we do have, as I said, the written opinion of the Board and the supportive testimony.

MR. MILLER: Mr. Chairman.

MR. MAYO: Mr. Miller.

MR. MILLER: I think that Mr. Purdy raises some pretty good questions and questions that mayors of the cities have raised with us when we have required them to go to 80 percent phosphorus removal, and it is sometimes difficult, when you have just gone around and are now completing the 80 percent, to come back and say you have to go to 90 or 1 mg/l.

Mr. Hert and I had some discussion of this this morning. He raised this question, and my concern is: What is necessary for the protection of Lake Michigan? And if it is the maximum feasibility as far as removal of phosphorus is concerned, then I think this is what we have to go to.

I am sure, as Mr. Schraufnagel and also Dr. Barth last night point out, that there are things that affect the removal process, and we may not at all plants be able to achieve 1 mg/l. And I can come back to Mr. McDonald and agree with him that we make a determination but sometimes it makes a difference who determines what is technically feasible and what is not technically feasible.

But I think the crux is: Is it necessary to maximize? And, on the basis of what I have heard, I believe that it is, and as much as I would like to have the support of all of the citizens in rising up and asking for this, I little think that they will, and that we, in Indiana at least, would, even though we are in the first round and not completed on this, be going back to the citizens and the cities to maximize phosphorus removal and hopefully, as a goal, the 1 mg/l.

Now, I think we do need more study in this area to come up with the different types of plants and the effects of various industrial wastes that it may have, and that would apply as to whether we can achieve this in all of the plants or not.

MR. PURDY: Mr. Chairman.

I think we in Michigan have recognized that an 80 percent removal, as a criterion, would be an interim step, and that at some point in time an effluent requirement would be established. We are discussing that sort of effluent requirement today.

I am certain it is going to be difficult to go back before we have even accomplished the 80 percent.

But -- as to our yardstick of measuring -- have we maximized the operational facilities to accomplish the best in phosphorus removal? I, too, have concern about reaching the 1 mg/l on an average 24-hour basis or maybe even on an average month. And in some instances we may be able to do even better with the same chemical cost.

I am not sure how we should measure if we maximize our ability to do this. But one thought would be to determine that those facilities were, in fact, feeding the proper chemical dosage, such as recommended by Dr. Barth, at 1.5 to 1.7 mole ratio of metal ion to phosphorus, and then, in addition to that, he gave what he considered to be key design parameters for the sediment facilities.

Rather than using that, I think we ought to have some advice from Dr. Barth as to what he considers a proper effluent concentration of suspended solids now, if this is 10 or 15 or whatever it might be. Then if we have that as proper chemical dosage and have reduced the suspended solids level down to this recommended level, could this, then, be considered a yardstick of maximizing the phosphorus removal with the objective of reaching the 1 mg/l level? I think that, in many instances, we are going to have to go beyond central settling, and we are going to end up with considerable capital costs in the way of filtering equipment.

MR. FETTEROLF: Mr. Chairman.

There is an old economic statement that there is no such thing as a free lunch, and Barry Commoner applied this to ecology. And in line with what Mr. Purdy was saying, if we have 10 mg/l of phosphorus in treated sewage effluents, and we come to an 80 percent removal, essentially that leaves us with 2 mg/l of phosphorus.

In order to get down to 1 mg/l, which would be the accomplishment of the 90 percent removal, it is going to require probably an additional 3 mg/l of ferric chloride applied, which results upon an added 1.5 mg/l of chloride to the discharge.

Now, yesterday you heard Michigan talk on the Status of Compliance report relative to chloride removal in control of discharges to the lake.

In 1972, it had a total of 2,400,000 pounds per day discharged at the six identified point sources who were working very hard on this to get this down. It is now down — by the end of 1973, it will be down to 805,000 pounds per day.

Just from some quick figuring, to go from 80 to 90 percent, we are going to be adding some 2 million pounds per year of chlorides to achieve the reduction of the additional mg/l of phosphorus. So it isn't all clear sailing on the additional 10 percent removal.

MR. McDONALD: You say 2 million a year will be added? What are Michigan sources putting in per year now?

Discussion - Phosphorus

MR. FETTEROLF: Much more than that.

MR. McDONALD: How much roughly?

MR. PURDY: In my report yesterday I think I mentioned that the 1968 figure was something like 4 million pounds a day, and we are down to 2 million pounds a day now, and when the control program has been completed, we will be in the neighborhood of 800,000 pounds per day.

MR. McDONALD: Per day. And Mr. Fetterolf is talking 2 million pounds per year?

MR. FETTEROLF: Which is not in the same ballpark, but it is something to consider.

MR. McDONALD: Well, it is not anywhere near the same ballpark.

MR. MAYO: Gentlemen, in the normal procedure of the conference activities, with a recommendation of this kind, the conferees, at their discretion, might incorporate that kind of a recommendation as part of the conclusions of the conference. The recommendations, then, would be contained in the summary and conclusions that would be issued by the Administrator.

The fact that the recommendation is in that summary and conclusions doesn't eliminate the need for the States individually, then -- to the extent that they don't already have comparable requirements -- to return to their respective pollution control agencies and to put this issue before the agency, with whatever public review and debate would be appropriate. So that the conference recommendation doesn't exclude the opportunity for local people -- whether they be municipal interests, industrial interests, or conservationist groups -- to have an adequate dialogue on the reasonableness of that kind of a requirement in the State water quality standards.

So I think the conferees can indeed be on reasonably firm ground that a recommendation of that kind in the conference certainly does not deny the opportunity for additional and perhaps very substantive dialogue on those issues when they come before the State water pollution control agencies. And certainly there ought to be available at that occasion whatever technical support EPA can provide, and whatever support can be reasonably generated from those interests who are willing to speak to the water quality issues in Lake Michigan versus the aspect of associated costs.

MR. PURDY: Mr. Chairman, I am inclined to feel like Mr. Miller that it is time for an effluent requirement on phosphorus removal. Following some of the testimony yesterday, we should apply the best control possible on phosphorus removal.

I am concerned as to how we measure that we have applied the best control possible.

I am concerned about -- at this point in time -- saying that it will be accomplished by a certain date.

1. I would like an opportunity to review in detail, on specific installations, what this might be in the way of additional capital expenditures for those plants, if any.

2. I would like to be able to relate this to a construction grant program and the amount of funds that are available for the State of Michigan, if there is a construction grant program.

3. I would like to be able to relate this to the requirements that there might be in a new Federal bill for certain minimum levels of treatment throughout the State.

4. I would like to be able to relate this to the other enforcement requirements that we have in the State -- for example, the Lake Erie Enforcement Conference.

So that, with those uncertainties, I am reluctant to, at this point, say that I am ready to set 1973, 1974, or 1975, as a date to accomplish this. I think we need to assess this, and do it as rapidly as possible. But I don't think that we can divorce a construction grant program from our enforcement activities anymore.

Discussion - Phosphorus

MR. BLASER: Question on the International Joint Commission agreement coming ultimately from Canada as well as the United States. Was there not provision for 1 mg/l in that? As I understand that, did not the States concur on that, or to what extent is the position different here than in the IJC situation -- International Joint Commission proposal?

MR. MAYO: Well, by way of comment, Mr. Blaser, the U.S.-Canadian agreement established as an objective 1 mg/l in sewage treatment plant effluents for plants, as I recall, larger than 1 million gallons per day. The agreement was signed by the two governments with the States being very intimately involved in the whole discussion and a good deal of the negotiation process.

The agreement isn't binding on the States as signators, since they were not signators. But the agreement does reflect the positions of the two Federal Governments in setting those objectives. Each government, then, in turn, assumes the responsibility of going back to the States on the U.S. side, the Province of Ontario on the Canadian side, and seeking to get incorporated into the day-to-day water pollution control practices of the individual States comparable requirements, or requirements that are compatible with the objectives identified in the agreement.

One of the responsibilities that EPA then assumed, as the consequence of the agreement, was to establish the dialogue with the States that would seek to bring into the State water quality standards those changes that might be necessary in order to make these State water quality standards compatible with the objectives of the U.S.-Canadian agreement, and that dialogue has been initiated.

What we are talking about today is quite directly related to the objectives that were established by the two governments in the agreement. And I think that the commentary here is quite significant in terms of our efforts to move ahead collectively with the States and get that objective -- in this case, the phosphorus objective -- in the agreement translated into the water quality standards of the individual States.

MR. PURDY: Mr. Mayo, is not the agreement objective just covering the Lake Ontario and Lake Erie waters at the present time, and is not the agreement on the remaining international waters to be determined at a later point in time by joint agreement between the U.S. and Canada?

MR. MAYO: Yes, the agreement sets up provisions for study of the upper lakes and the establishment of objectives for the upper lakes. Yes, that is correct.

MR. PURDY: But the agreement, at the present time, of 1 mg/l of sewage treatment plants of over 1 million gallons per day, covers Lake Erie and Lake Ontario?

MR. MAYO: And the associated boundary waters.

MR. PURDY: But not Lake Huron and Lake Superior.

MR. MAYO: Well, it doesn't, because the studies that led up to the agreement, the lower lakes studies and the report associated with the developed recommendations were specific for those waters.

MR. PURDY: If we should come up with something different than that today for Lake Michigan, it would not be, at this point in time, a violation of the agreement.

MR. MAYO: I don't think it would.

MR. BRYSON: I think there is a comment that needs to be made at this point: that we appear to be settling in on a difference between 80 percent removal and 90 percent removal.

If I recollect a couple of the sessions of the committee meetings that I sat in on, we are not talking that kind of a difference.

Let me get Howard Zar back up here to explain the committee's reasoning on the difference between 1 mg/l and the 80 percent removal that is currently in effect.

MR. ZAR: Correct. The 80 percent removal requirement, which is presently in force, is a basinwide requirement, and the smaller sewage treatment plants are excluded generally in the application of this regulation by the States. So that when you apply the regulation to the plants that need to accomplish this treatment, you are talking about something like 83, 84 percent treatment, or perhaps more, that these plants have to do.

In the application of the 1 mg/l requirement, smaller plants would also be excluded, and if you take and apply this 1 mg/l restriction to these remaining plants on a basinwide basis, you would be getting 87 percent. So you are talking about the difference between 80 and 87 percent, perhaps, basinwide, or 83 and 90 percent at the sewage treatment plants that have to do this treatment. So there is perhaps a 7 percent difference instead of a 10 percent difference, and perhaps that explains the slightly lower cost that the committee uses compared with those that Mr. Purdy mentioned earlier.

MR. BRYSON: Seven percent on the outside. It could be as low as 3 to 4 percent.

MR. ZAR: Presumably.

There is another perhaps misimpression. Mr. McDonald used the figure of 1 cent per capita per day. I think that we talked about that back there, and that referred to the total treatment cost for phosphorus and everything; whereas, if you take a cent per thousand gallons --

MR. McDONALD: I think that is what I said, Mr. Zar, that that was the total cost: $75 per million gallons.

MR. ZAR: Okay. I'm sorry. It wasn't clear back there.

Perhaps I should make it clear that the cent per thousand gallons works out to about a tenth of a cent per capita per day for this additional phosphorus treatment we are talking about.

MR. McDONALD: That is a good point. Now we are down to a tenth of a cent.

MR. MAYO: Do you want to continue this dialogue, gentlemen, or do you want to get back at it when we get into Executive Session and begin to look at specific recommendations?

MR. FRANGOS: Well, I would like to continue for a few moments. And one of the things that troubles me about setting the suggested limitation of doing this by December of 1972 -- is that correct? Is that the interpretation?

Well, that first sentence on page 12 is a little ambiguous. Is there a time statement indirectly made?

MR. ZAR: There is not.

MR. FRANGOS: There is not.

Does the fact of setting this kind of effluent limitation cut down on the flexibility of operating a program? And it seems to me that 90 percent or 88 percent is not a magic figure, and I think my position at this time is that we don't use 80 percent as being the maximum that we would require of our communities, but rather would ask that they maximize efficiencies with the facilities that they are now going to install or have installed.

Quite frankly, I don't know the detailed effect of setting this kind of a limitation as stated in the report on a number of our communities in Wisconsin. And until I do, then I don't see how we could go along with the kind of a recommendation that is stated on page 12. And, further, I really don't think that we want to sign off on a recommendation, take it back, and then back off.

MR. MAYO: Well, as has been the custom at the conferences, Mr. Frangos, when we get into Executive Session, the conferees will generally have a set of recommendations before them to speak to. I think it might be appropriate at that time to get into the discussion of what might be a reasonable implementation date that would be related to a recommendation dealing with the 1 mg/l maximum concentration of total phosphorus in the sewage treatment plant effluent and get at the issue at that time in terms of a specific recommendation.

MR. FRANGOS: It sounds good to me. It is getting to be lunch time.

MR. MAYO: As far as the conferees are concerned, if you feel you have had sufficient commentary and dialogue on the phosphorus issue that we can --

DR. KITCHEL: Mr. Chairman, I think we are all in agreement that to eliminate phosphorus or limit it to the lowest reasonable level is the desirable goal.

Our troubles in Michigan do not stem from agency activities or problems; I think all our confusion comes from Congress.

MR. MAYO: Do you feel that that confusion is confined to Michigan? (Laughter)

DR. KITCHEL: It was remarked here a little bit earlier that there is no such thing as a free lunch and yet Congress insists on describing that terrific free lunch they are going to set out and now they are proposing to increase it.

I think the judicious application of "the carrot and the stick" is the way we will achieve these things. And right now, when we don't know what this carrot is going to look like the rest of this year or next year, we are in a position where it is difficult to fix on goals, particularly on a time schedule.

So while I would agree that the 1 mg total -- perhaps stated a little differently than it is here -- is reasonable; it is feasible; to put a time sequence on it right now is practically impossible.

MR. McDONALD: I would say to that, before we get into the Executive Session discussion, if we don't have a deadline date by which to do it, that the recommendation is going to be strictly advisory, recognizing exactly what you say, Dr. Kitchel, that it is difficult not knowing what new legislation may offer.

Nevertheless, in the context of where we are today, where we are meeting today, the recommendations we have to come up with, it seems to me we have to talk in terms of a deadline -- an agreed-upon deadline to do what has to be done.

MR. PURDY: I can't let it drop.

I have felt for the last year and a half that Congress must act on the construction grant program and put some sense in where we are going. They have failed to do that.

I can't see why we are under any greater compulsion to act and set a deadline certain, at this point in time, in the absence of some definition from Congress. I have felt that it was just impossible that Congress could hold back $350 million of last year's appropriation. It could be building $700 million worth of sewage treatment construction in this country today. But yet it has been held back as a carrot to pass new legislation, and I don't see where we should be compelled to act on a date certain any more than Congress is compelled to act on a definition of the construction grant program.

I do feel that we have to set a time. I don't think that we can set the time until we have had an opportunity to see where we are going in the construction grant program, and that we must tie our enforcement efforts to the future construction grant program.

MR. MAYO: With that commentary on the part of Mr. Purdy, I think it would be appropriate for us to leave the phosphorus item on the agenda, at this point, and return to it in the format of the Executive Session and the consideration of specific recommendations. If that is agreeable with the conferees, we can recess for lunch at this time and return at 1:45 and proceed with the portion of the agenda that deals with the pesticides issue.

(Noon recess.)

WEDNESDAY AFTERNOON SESSION

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MR. MAYO: Gentlemen, I think it is important that we get started. Mr. Blaser may not be here for another few minutes.

The next item on the agenda, Item 4, deals with the reports of the Pesticide Committee and subject matter of pesticides, PCB's, phthalates, and heavy metals.

I will turn this over to Mr. Bryson to proceed with the identification of those who will be making the individual reports for the Pesticides Committee.

MR. BRYSON: The Pesticides Committee will consist of three parts: 1) the report on pesticides, 2) the report on PCB-phthalates, and 3) the report on heavy metals.

The first portion, the pesticide report, will be given by Mr. Lloyd Lueschow from the State of Wisconsin.

STATEMENT OF LLOYD LUESCHOW,
CHIEF, LABORATORY SERVICES,
WISCONSIN DEPARTMENT OF NATURAI RESOURCES,
MADISON, WISCONSIN

MR. LUESCHOW: The Lake Michigan Enforcement Conference Pesticide Committee was created in 1968 to function as a technical advisory unit to the conference. The committee issued a summary review report and a series of recommendations in November 1968.

The participating States, the Environmental Protection Agency, the Bureau of Sport Fisheries and Wildlife, and the Wisconsin Alumni Research Foundation all collaborated in meeting the basic outline accepted by the conferees in February 1969. The committee hereby offers conclusions and recommendations for the consideration of the conferees:

1. The analysis of water samples from the open waters of Lake Michigan strongly suggests a real and inherent variability that makes water sampling for the purpose of developing general residue levels impractical. The concentrations present challenge the limit of detectability of the analytical methods employed. Several laboratories recorded substantial analytical discrepancy when analyzing split samples, thereby further complicating interpretation of results.

2. After cautious interpretation of the data, the committee generally agreed that the most likely concentrations of DDT in open lake waters were between 1 and 10 parts per trillion. Those analyses that revealed unusually high levels of pesticide were probably the result of artifacts such as surface scums of floating oils, suspended

debris or in-laboratory contamination.

3. The data accumulated by municipal water intake sampling strongly suggest concentrations of chlorinated hydrocarbon pesticides in the inshore waters were higher than in open lake waters and much more variable. The biological accumulation potential is, therefore, greater in inshore waters since most of the important biological representatives spend an extended period of time within these inshore water areas.

4. Tributary streams to Lake Michigan discharge chlorinated hydrocarbon pesticides into the lake. Urban and fruit-growing areas are the more significant contributors of pesticides to the lake than are diversified agricultural areas.

5. Dieldrin levels in tributary streams and lake waters were generally at the limit of detectability, 1 part per trillion or less.

6. Most sewage treatment plant discharges contained less than 10 parts per trillion DDT. For those plants with more than 10 parts per trillion total DDT, there were likely point sources. However, in the city of Milwaukee, no point source was found. The Milwaukee system is so complex that it is virtually impossible to eliminate all potential sources by field investigation. Sewage treatment plants

with dieldrin concentrations above the detectable levels also had identifiable point sources.

7. Lake Michigan waters contain many substances that are extractable and measurable by commonly used methods for pesticide analyses and are, therefore, potential interferences in typical pesticide analytical procedures. The polychlorinated biphenyls constitute a complex of such substances that are present in Lake Michigan. Phthalate esters more recently have been identified at detectable levels. These chemicals are present in greater concentrations in biological and wastewater samples than in open lake waters. The polychlorinated biphenyls are present in sufficient quantity, with sufficient evidence of biological impact, to warrant an independent evaluation.

8. Biological sampling with sentinel organisms (clams) reflected unusually high pesticide concentrations and sources. Subtle concentration differences that might be brought about by a relatively small discharge relative to the stream could not be detected by clam analyses. Resident arthropods generally contained higher levels of DDT and its analogs than sentinel clams. Resident fish appeared to be the most reliable biological monitor.

9. The biological magnification of chlorinated hydrocarbon insecticides in sport and commercially valuable

species of fish suggests that fish should be used to reflect concentration trends in the lake water. It is believed that the residue levels established during the last 2 years will be adequate to serve as a base line to establish the trend in future years. It seems unlikely these trends can be conveniently established by water sampling because of analytical and sampling complications.

10. The levels of DDT in sport and commercially valuable species of fish exceed the 5 parts per million action level established by the Food and Drug Administration, essentially preventing sale of Lake Michigan fish. Other chlorinated hydrocarbon pesticides do not exceed the established residue tolerances, although dieldrin levels approach the action limit. Exotic chemicals other than chlorinated hydrocarbons were not measured in this study.

I should elaborate on that just slightly in that they were looked at in the original evaluations and residues in the lake water were not observed. It was reported in the November 1968 report that that did not imply that they should never be looked at; it only meant that we had other problems, more pressing at the moment, than those problems with DDT and dieldrin.

11. The four States in the Lake Michigan Drainage Basin have adopted legislation authorizing various pesticide

use control programs. Wisconsin, through basic legislation and subsequent rules, has essentially prohibited the use of chlorinated hydrocarbons that have been found in Lake Michigan. Michigan and Indiana have adopted adequate use control legislation but the rules have not yet been promulgated. Illinois has a legislative restriction on DDT but not on other chlorinated hydrocarbons. Michigan, Illinois, and Indiana have adopted legislation regulating commercial pesticide applicators. Wisconsin legislation regulating commercial applicators is still pending.

12. The effect of the pesticides in Lake Michigan on fish reproduction potential is not resolved as yet. This concern in part generated the establishment of a technical committee to review pesticide pollution in the lake. Both Wisconsin and Michigan are able to hatch and rear coho fry in adequate numbers to sustain the anadromous fish stocking program using Lake Michigan brood fish. The effect on natural reproduction in lake trout is not known.

13. The pesticides in Lake Michigan through biological magnification may have a potential effect on both domestic and wild animals that eat fish or other organisms from the lake. Hazards to wild bird populations and mink-ranching operations are being investigated. Preliminary data suggest that exotic chemicals including chlorinated hydrocarbon

insecticides produce measurable changes on reproductive potentials.

Recommendations

1. Fish sampling for pesticide residues should be established in accordance with the Bureau of Sport Fisheries and Wildlife and commercial fisheries' recommendations. This monitoring should be conducted within the Federal structure or should be contracted to an agency with the ability both to collect and process the collections from the entire lake. Analyses and sampling must be performed in the same way in order to compare data or correlation data must be established if new collection or analytical techniques are used.

2. A water quality monitoring program should be initiated for inshore waters in order to determine whether the pesticide burden of fish is related to the pesticide concentration of inshore waters.

3. The conferees should insist on adequate legislation to record pesticide usage of other than the chlorinated hydrocarbons.

4. As with pesticides, the discharge of polychlorinated biphenyls, phthalates and other persistent chemicals should be abated to prevent accumulations of these persistent compounds in Lake Michigan. Particular attention should be

devoted to possible replacements for chlorinated hydrocarbons such as toxaphene, methoxychlor, chlordane and benzene hexachloride.

5. The levels of metal contamination of Lake Michigan water and/or fish should be clearly established at this time so that residue trends can be assessed in the future.

6. Polychlorinated biphenyl concentrations should be ascertained for water and fish. Control programs for polychlorinated biphenyls and other exotic chemicals should be initiated. That is the end of the statement.

MR. MAYO: Gentlemen, you have before you the statement that was just presented as well as the published materials that were contained in the distributions made to the conferees prior to the conference.

(The document entitled "An Evaluation of DDT and Dieldrin in Lake Michigan" is on file at U.S. EPA Headquarters, Washington, D.C., and Region V Office, Chicago, Illinois.)

MR. MAYO: The Technical Committee representatives who are here are available for discussion of any questions or comments or concerns that you may have.

MR. PURDY: Mr. Lueschow mentioned that Conclusion No. 11 might need updating. The Department of Agriculture has adopted Rule 632 to implement Public Act 233 of 1959, as amended, which relates to the regulation of commercial applicators; and Regulation 633 to implement the Public Act 297 of 1949, as amended, the Economic Poison Control Act, so that the regulations for both of those pieces of legislation have been adopted and are now in effect.

MR. LUESCHOW: The status of legislation is that of a fluid situation since this was written 4 or 5 months ago, and I am sure the legislation can and has proceeded in some cases and will continue to do so.

MR. MAYO: Mr. Bryson.

MR. BRYSON: Mr. Lueschow.

MR. LUESCHOW: Yes.

MR. BRYSON: Can you give the conferees some sort of a feel for what reduction in loading into the lake has occurred since the pesticide program started a couple of years ago?

MR. LUESCHOW: Not really, in that when we first got the charge of the conferees to abate pesticides or to review the status of pesticide inputs, most point sources had already been under enforcement action. The pesticides that were getting into the lake were essentially of a diffuse nature -- at least the dieldrin and DDT that we were principally concerned with. They were coming from diffuse sources -- agricultural runoffs, sediment carried -- rather than a nice precise point discharge.

Obviously the most difficult item of discharge was to determine the poundage coming in from the diffuse sources to river systems.

I think the States -- instead of waiting for this type of data -- just said, it is undesirable. And instead they essentially banned the use of the two products that were showing up.

So even though it was getting in then and is getting in now, to calculate poundage was difficult then; it is as difficult now; but it seems like the best enforcement procedure has taken place. In other words, it is not used. So it must slowly die away from whatever concentration it was.

MR. BRYSON: That leads to the next question: Does the committee have any feel for how long a period that die-away is going to mean? Are we talking 10 years, a decade, decades?

MR. LUESCHOW: Certainly not land-contributed diffuse source contributions. We are talking about an extended period of time. These materials have been incorporated into the soils over a long period of time and are going to continue to wash away.

I do feel that within the first 4 or 5 years a substantial decrease in contribution should take place, and particularly a substantial decrease in the available -- in other words, the nonadsorbed type -- chlorine hydrocarbons should take place; a substantial decrease should take place. I am offering you my feel of that data at this point.

MR. MAYO: In the committee's Conclusion No. 10, you comment on the fact that "... valuable species of fish exceed the 5 parts per million action level established by the Food and Drug Administration ....".

Do you see any early opportunity for those levels of DDT in fish to be reduced below the action level if indeed we are faced with a very slow die-off rate?

MR. LUESCHOW: It has generally been assumed that the die-off rate of pesticides in the lake is very, very slow. However, Dr. Lee yesterday brought up some interesting considerations initially that I am not sure we of the Pesticides Committee had fully appreciated in that if -- the chlorinated hydrocarbons that we are dealing with are markedly insoluble, and they may have several resemblances due to this insolubility with phosphorus -- if this holds true, then you might expect the same kind of a die-away pattern that Dr. Lee is predicting for phosphorus.

Now, we cannot really establish that phosphorus is indeed going to be -- or excuse me -- that the pesticides are indeed going to behave exactly like phosphorus, but it shouldn't be too far from it, and if that is the case, then we should have a moderately rapid die-away of the currently heavy hydrocarbons currently existing in the lake back to a level that represents the new input consistent with legislation that has essentially banned the use of these products.

MR. McDONALD: Mr. Lueschow, what is the general reliability of the analytical techniques for testing for pesticides at low levels on a consistent basis?

MR. LUESCHOW: As they exist in the Lake Michigan water?

MR. McDONALD: Yes.

MR. LUESCHOW: Analytical reliability is terrible, at the 1 part per trillion limit of detectability.

MR. McDONALD: Well, your recommendation, or the committee recommendation suggests the program of apparently rather extensive water quality monitoring.

MR. LUESCHOW: Not extensive water quality monitoring, sir. We do face up to the question of the difference in concentrations in the inshore waters and open waters. We suggest fish monitoring as a method of evaluating the die-away in the lake, and the fish monitoring, of course, brings the concentration through a magnification process into the realm of reasonable analytical reliability. We are not promoting an extensive program on water monitoring.

MR. McDONALD: So you are not taking a technique that is so variable that it doesn't mean too much.

MR. LUESCHOW: That is right. We have tried to rule this out. In fact, it was our efforts to establish these low levels that led us to this conclusion.

MR. MAYO: But you wouldn't be addressing yourself to monitoring for the presence of these pesticide materials in water in the nearshore area.

MR. LUESCHOW: In some nearshore areas, that is correct. I think there can be some selection there, too.

MR. MAYO: Selection being related perhaps to the locale of urban development --

MR. LUESCHOW: That is correct.

MR. MAYO: -- the location of major tributaries with significant waste loads?

MR. LUESCHOW: That is right. That is exactly right.

MR. McDONALD: What is taking place, in your judgment, to improve the analytical techniques? Is there anything on the horizon to make them more precise, more reliable?

MR. LUESCHOW: Well, since this committee began its deliberations, there has been a tremendous improvement in analytical reliability strictly in identification. Our earliest analyses were subject to considerable identification error. The development of mass spec resolved this to a certain extent. There has been good analytical progress in separating some of the artifacts that we had been observing and sometimes including in the pesticide complex and sometimes not.

I see nothing in the immediate future that offers any better judgment than the 1 part per trillion limit of detectability in water.

MR. McDONALD: Who is doing most of the work on this to improve the techniques? Where is it concentrated?

MR. LUESCHOW: Most of that work -- a good share of it -- I am not familiar with the people that are doing that type of work.

MR. McDONALD: I wonder if anyone on the committee knows that; if anyone is here that could maybe give more information on the analytical techniques that may be on the horizon.

If you are going to start an inshore sampling program, you have inherent problems with your techniques, right?

MR. LUESCHOW: The inshore sampling program is not -- is recommended not because I don't think there are problems with analytical techniques. There the concentrations in many cases -- in most cases went 10 parts per trillion -- in many cases went 50. This isn't posing us any real analytical problems. The difficulty in inshore sampling is the fact that you don't have a uniform distribution of the product. You have wave action, and so forth. But the concentrations in inshore waters are high enough so that analysis really isn't our problem. It is the number of analyses.

MR. McDONALD: Okay.

MR. LUESCHOW: I don't think we really need additional sensitivity in this particular case, which is dawning on me that that is what you have been alluding to here, and I don't think that is really what is necessary.

MR. McDONALD: Why do you say that? Why don't you need additional sensitivity?

MR. LUESCHOW: Well. Okay. Don't get me wrong. If we had additional sensitivity -- good realiable analytical techniques for open water -- we might indeed recommend open water sampling. I think there is an adequate alternative to that which is open water fish sampling.

MR. McDONALD: Would you ever need open water sampling if you did open water fish sampling to complement your program?

MR. LUESCHOW: Well, it would certainly be nice, but I don't really see it as a necessity at this time. I think there is a way around it.

MR. PURDY: Mr. Lueschow, there has been a fish monitoring program for quite sometime; quite a little data has accumulated.

Does this data show any indication at all of a trend developing from action that has already been taken to limit the usage of DDT and dieldrin within the basin?

MR. LUESCHOW: The data that currently exists was presented to the Five-State Interdisciplinary Committee by representatives of the Fish and Wildlife Service a month or so ago and, at that time, the data suggested -- didn't establish -- suggested that there has been a reduction in the concentration in fish, further suggesting this would represent bioreduction of the water and reduction in the input. It does not establish it. We haven't gone that far.

MR. MAYO: Any other questions, gentlemen?

MR. BRYSON: I have an additional question, Mr. Mayo.

Mr. Lueschow, who would you envision undertaking and implementing some of these recommendations that the committee has come forward with -- for example, No. 1. "Fish sampling for pesticide residues should be established in accordance with ..." etc., etc.

MR. LUESCHOW: The committee refused actually to establish who should do it. I think the general consensus or feeling was that it should be the Fish and Wildlife Service, particularly the Ann Arbor laboratory which has the capacity and the facilities to do it and has been doing it in the past.

MR. BRYSON: How about No. 2 then, a water quality monitoring program.

MR. LUESCHOW: The committee, again, did not take a position on that. In that particular case I can offer only a personal position that it would have to be done by the States and municipalities on selective sites. I say municipalities because they are the ones that are -- like Chicago -- that has a large urban input in a specific area, or something of this nature.

MR. BRYSON: Supplemented with the State monitoring program?

MR. LUESCHOW: Yes.

MR. BRYSON: How would you envision No. 5 being implemented?

MR. LUESCHOW: I am not in a position to suggest any type of waste treatment. That recommendation was based on the fact that here we have very similar compounds -- or at least one of them was very similar to the pesticide question — and if there are ways of abating it within the realm of economic reason, you should proceed with this type of approach.

I do understand that there are techniques available for reducing items like polychlorinated biphenyls, but I don't really try to promote any one of them.

MR. BRYSON: The reason I asked this is the conferees represent the regulatory agencies around the State --

MR. LUESCHOW: Sure.

MR. BRYSON: -- or around the lake, and they are charged with implementing an abatement program. If the committee develops a series of recommendations, I think there would be great frustration on the part of the conferees in not being able to get a handle on how to go forward to do something about the recommendations. That is why I am trying to zero in on the recommendations.

MR. LUESCHOW: In this particular report, we recognize the difficulties proposed by the present polychlorinated biphenyls. At least it was followed up with additional work by the Pesticide Committee which will be reported on further along in this investigation, and we are still not to the point, I don't think, of being able to recommend a technique for abatement on these particular products, if indeed that is desired from the Pesticide Committee.

Actually the Pesticide Committee was not constituted in such a way to address itself to that particular aspect of the challenge. They were ecology-oriented, not waste treatment-oriented.

MR. BRYSON: In other words, you determine the problem and hope that somebody will come up with a method.

MR. LUESCHOW: We are continuing to face up to this, but we aren't as far along with this particular aspect of the question as we are with the dieldrin aspect of it. It was a Johnny-come-lately question really.

MR. MAYO: In Recommendation No. 4, the committee addressed itself to the need for attention to the possible replacement for chlorinated hydrocarbons, such as toxaphene, methoxychlor, chlordane, and benzene hexachloride.

Did the committee give any consideration to available replacement material?

MR. LUESCHOW: No. This aspect of the recommendation was brought out because at the time that the committee began its deliberations, early samples were taken to determine exactly what pesticides we were dealing with as residues. We determined the ones we were dealing with were

-- as residues relating to technical residues -- were dieldrin and DDT.

After we were convinced we could achieve reduction in the lake by abatement procedures, then it became obvious that even though these particular products could not be detected at that time -- and I don't think at this time -- since the products we were concerned with were being reduced, the four products listed were potential replacements and they, then, might get such extensive use we could begin detecting them sometime in the future. And we feel that we should watch for these four particular ones at least, which we are continuing to do, by the way.

MR. MAYO: At the present time, is there any quantitative evaluation in terms of the amounts of these materials that are being used in the lake?

MR. LUESCHOW: I don't think so; no, sir. But that is one of the reasons we put forth another recommendation, No. 3, which said: "The conferees should insist on adequate legislation to record pesticide usage of other than the chlorinated hydrocarbons." And that includes all pesticides, in other words.

MR. MAYO: Are there any other questions, gentlemen?

MR. FETTEROLF: Mr. Chairman.

I would like to know if there is going to be a report given on phthalates and PCB's.

MR. MAYO: Yes.

MR. FETTEROLF: All right. Fine.

MR. MAYO: Thank you, Mr. Lueschow.

MR. BRYSON: The next agenda item will be the report on PCB's and phthalates. I would like to call upon Dr. Donald Mount, the Director of the National Water Quality Laboratory at Duluth, to present that report.

STATEMENT OF DR. DONALD MOUNT, DIRECTOR,
NATIONAL WATER QUALITY LABORATORY,
U.S. ENVIRONMENTAL PROTECTION AGENCY,
DULUTH, MINNESOTA

DR. MOUNT: My name is Donald Mount. I am Director of the National Water Quality Laboratory, EPA, Duluth, Minnesota.

Mr. Chairman, if it is agreeable with you and the conferees, I would propose that we submit the PCB and phthalate report, as you have in your handout, into the record as though read, and then I would just make a few comments and highlight some of the points, if that is all right with you.

MR. MAYO: Any objection, gentlemen?

(The document above referred to follows in its entirety.)

REPORT OF
THE PESTICIDES TECHNICAL COMMITTEE
TO
THE LAKE MICHIGAN ENFORCEMENT CONFERENCE
ON
PCB AND PHTHALATE

SEPTEMBER 1972

POLYCHLORINATED BI-PHENYLS (PCB)

PCB residues related to fish species important in Lake Michigan were measured prior to 1971 by the Wisconsin Department of Natural Resources, the Michigan Water Resources Commission, and the Great Lakes Fisheries Laboratory at Ann Arbor, Michigan. The limited data were confirmed by the Fish Pesticide Laboratory at Columbia, Missouri using mass spectrometry.

In the March 23, 1971, progress report of the Lake Michigan Interstate Pesticide Committee, Dr. Mount mentioned to you that a grant agreement had been developed with Dr. Gilman Veith at the University of Wisconsin to participate in a study designed to further examine the PCB problem in the Lake Michigan basin. Since that time, the grant was funded by the Federal Environmental Protection Agency (EPA) and Dr. Veith has completed his portion of the study including positive identification through perchlorination and mass spectrometry of the important isomers of Lake Michigan PCB residues. As a result of Dr. Veith's isomer characterization, hopefully it will now be possible to identify important Lake Michigan basin PCB sources.

The National Water Quality Laboratory in Duluth and the Bureau of Sports Fisheries and Wildlife Pesticide Laboratory are also both presently conducting independent bioassay and related tests to determine the toxicity and metabolic uptake of PCB in aquatic organisms. Research to date indicates that substitution on the bi-phenyl nucleus with intermediate numbers of chlorine atoms produces the more toxic PCB and that the PCB concentration or biological magnification factor from water to tissue is extremely large, as high as 200,000 in fathead minnows chronically exposed to Arochlor 1242 and 1254 for eight weeks. Theoretically this can be expected since PCB is a non-polar, fat soluble, aromatic hydrocarbon which is not readily degraded in zoological systems. In addition the research to date suggests strongly that PCB residues in adult

Atlantic and Pacific salmon can cause 100 percent mortality in salmon offspring, and that these residues can be produced by chronic exposure to PCB in water in the low parts per trillion (pptr) range. This extreme chronic toxicity is not surprising considering the extensive biological magnification of PCB and its resistance to enzymatic degradation.

The Federal Food and Drug Administration has selected an action level of 5 ppm PCB for fish flesh. Unfortunately, I must report to you that in certain Lake Michigan species, particularly the coho salmon and lake trout, this level is presently being exceeded, with residues as high as 20 ppm. Research by Ringer and Aldrich at Michigan State University indicates poor reproductive success for mink placed on a diet of 30 percent Lake Michigan coho. Control tests with ocean fish and the aromatic hydrocarbons dieldrin, aldrin, and PCB definitely place the poor reproductive success of the mink upon PCB. Diets spiked with 1 ppm PCB resulted in 33 percent decreases in mink litter numbers. Diets spiked with 5 ppm PCB resulted in 85 percent decreases in litter numbers. In diets spiked with 30 ppm PCB all adult mink died in a period of 2 to 4 months.

Research by Hoopingarner and Samuel, also at Michigan State University, on Chinese hamster cells showed a 24-hour, 90 percent cell kill at 50 ppm Aroclor 1016 as compared to the control. At 25 ppm Aroclor 1016 the cell kill during the same period (24 hours) was 50 percent.

Both the States of Wisconsin and Michigan have conducted cursory surveillance of municipal sewage treatment plant effluents for the purpose of elucidating background levels of PCB. These surveys have shown that effluents from large cities - cities with extensive industrial discharge to municipal sewer systems - average approximately 200 pptr PCB. In smaller cities where the sewage treated is largely domestic in nature, the effluent PCB level averages less than 50 pptr. The State of Michigan has isolated several major PCB sources in the Bay city, Mt. Clemens, and Detroit areas, and is presently doing further investigative work elsewhere. The isolated PCB sources include process consumers of hydraulic and heat transfer fluids including automotive manufacturing installations, apartment complexes, and certain hospitals.

The committee believes that PCB is a significant pollutant in the Lake Michigan basin, and that it is imperative that present PCB levels in Lake Michigan be minimized if not eliminated. Future loss of PCB to the environment should be drastically reduced as a result of use restrictions presently in effect at the Monsanto Chemical Company, the only domestic producer of PCB. Monsanto has curtailed the sale of PCB for uses in which disposal of the end products could not be controlled, as with plasticizers. Large quantities, however, are still being synthesized for use as dielectric fluids in electrical capacitors and transformers. The committee has not presently determined the import extensiveness of foreign produced PCB. If this source of PCB shows signs of becoming significant, its import can be regulated under Section 114(c) of the Toxic Substances Act of 1972 now before Congress.

Presently, no state in the Lake Michigan basin has regulations governing the discharge of PCB. Michigan and Wisconsin, through respective Departments of Natural Resources, discourage the industrial use of PCB, however, these agencies can offer no alternative.

The committee recommends to the Lake Michigan Conferees that comprehensive surveillance by the States be initiated to determine PCB trends in the aquatic environment, and to determine whether the present policy of eliminating PCB discharges to the environment is effective. The surveillance program to be accomplished by the States should include sampling of municipal sewage treatment plants, industries, domestic water intakes, and fish. Furthermore, because of the persistence of PCB in the environment, and its extreme toxicity, the committee recommends that results of the surveillance be presented to the Conferees by September 1973, along with any measures instituted by the States to control the problem.

PHTHALATES

Phthlate esters are widely used as plasticizers, particularly in polyvinyl chloride (PVC) plastics. The most common phthalate ester plasticizer is di-2-ethylhexyl phthalate. Total phthalate ester production was reported to be 8.4 X 10^8 lbs. in 1968. PVC plastic formulations may contain 30-60 parts per hundred of phthalate ester plasticizer. Since the plasticizers are not chemically bound to the plastic resin, they are easily lost to the atmosphere or to liquids coming into contact with the plastic product. Other phthalate esters are used as insect repellants and in pesticide formulations to retard volatilization.

The occurrence of dialkyl phthalate residues has been established in the aquatic environment, principally in samples of water, sediment, and aquatic organisms from industrial and heavily populated areas. Based upon State of Michigan experience the concentrations of phthalates in wastewaters have been an order of magnitude greater than PCB. The Water Resources Commission estimates the Michigan phthalate environmental loss to be over 60,000 pounds per year.

Generally, research work on phthalates is proceeding more slowly. Data to determine status of environmental presence and effect are scarce. Contracts have been awarded to Union Carbide of Tarrtown, New Jersey. This facility is extremely competent to perform the full aquatic life cycle bioassay and residue tests as required by the contract. Data from this study will be available within a year after initiation of the study. In addition to the contractual work, the Bureau of Sports Fisheries and Wildlife Fish Pesticide Research Laboratory at Columbia is continuing research into chronic effects in fish and invertebrates, potential toxic phthalate metabolites, and more comprehensive analytical methods for phthalate and phthalate metabolite characterization. Full life cycle bioassays using fathead minnows as test animals are now in progress and chronic toxic effects will be evaluated by measuring spawning success, egg hatchability, and survival of young.

The committee's initial concern with phthalates as expressed to the Conferees earlier was based upon residue tests performed by the Bureau of Sports Fisheries and Wildlife on fish initially analyzed by the U.S.Department of Agriculture (USDA). USDA reported that the edible portions of those fish contained 20 to 30 ppm toxaphene. Using more sophisticated and precise analytical procedures, the Bureau of Sports Fisheries and Wildlife determined that the USDA "toxaphene residues" were in reality approximately 40 percent toxaphene 20 percent PCB, and 40 percent phthalate.

Research on phthalates to date indicates that residue levels are higher in cultured fish than fish taken under natural conditions. However, study fish caught in streams draining highly industrialized areas, such as the Hudson and Ohio Rivers, are also high in phthalate residues indicating extensive waste discharges to these streams. This indication is reasonable since evaluation of the study data leads to the conclusion that while under continuous exposure phthalate esters are biologically magnified and retained, when water residues decline, tissue residues expeditiously decline approximately 60 percent in three days for daphnia. Theoretically this can also be expected since the phthlates have greater polarity then PCB and are amenable to metabolic-enzymatic degradation. Finally, the study data indicate that the acute toxicity of phthlates to aquatic life apparently is relatively low although life cycle chronicity tests show that as little as 3 ppb phthlate reduces reproduction in Daphnia by 60 percent.

In a State of Michigan study, 36 sewage treatment plants were sampled and it was determined that the average phthlate concentration in the effluent was 15 ppb with most of it being di-2-ethylhexyl phthalate. Ten plants were in excess of 10 ppb and 2 plants were as high as 100 ppb.

In a cursory State of Illinois study, limited to the highly residential areas of the North Chicago suburbs and as far North as Waukegan, 28 water, 17 sediment, and 32 fish samples were analyzed for phthalate. The water samples contained less than 1 ppb, sediment less than 300 ppb, and the fish less than 1500 ppb. As in the Michigan study, most of the Illinois phthlate was in the di-2-ethylhexyl form.

Based primarily upon chronicity bioassay, the committee feels it is necessary to re-affirm our initial concern with environmental phthalate contamination and to recommend to the Conferees that comprehensive State surveillance of municipal sewage treatment plants, industries, domestic water intakes, and fish be initiated to determine phthlate trends in the aquatic environment. In addition, the committee recommends that the Conferees request the Federal Food and Drug Administration to further evaluate the problem to determine whether an action level for fish needs to be set.

MR. MAYO: Please go ahead on that basis, Dr. Mount.

DR. MOUNT: I think just a word or two about the history of this PCB question should be brought out here, and that was that, I believe in the spring of 1970, the conferees asked the Pesticide Committee to look into the question of PCB's in Lake Michigan.

We had a meeting subsequent to that request, and we found ourselves faced with several problems. One was, at that time, there was not sufficient analytical capability to measure PCB's, and I would remind you that this is not a single chemical but a whole family of chemicals, and it is not an easy measurement.

Secondly, we had no idea what level in the environment was significant, and therefore we didn't know what level we ought to be looking for in the environment.

So it was agreed that we would do two things: 1) first of all, the Duluth Laboratory, and also the Fish and Wildlife Lab in Columbia, Missouri, would press forward with toxicity work to find out what levels were important; and 2) secondly, we would fund a grant, which we subsequently did, at the University of Wisconsin, to measure PCB levels in Lake Michigan in the fish in particular, and specifically to look at what isomers were present in the fish as a possible clue to which of the formulations of Aroclor were most important and where they might be coming from.

We have nearly completed the work on the toxicity of PCB's and, in summary, I can simply say that most of the PCB's that are in common usage have adverse biological effects on organisms that are like, or are in Lake Michigan at concentrations in the range of 0.5 to 10.0 micrograms per liter or parts per billion. These are direct adverse toxic effects.

More importantly, however, the PCB's have turned out to be the organic -- of the organic chemicals that we have studied--they turn out to be more concentrated in biological organisms than any other chemical we have looked at. They exceed DDT.

We are finding that fish living in water concentrations that are completely harmless from the standpoint of direct toxicity are concentrated in the body of the animals in the order of 200,000 to 250,000 times. This has importance to the conferees and to all of us in that we are going to see high residues in the fish and other aquatic organisms from extremely low water concentrations.

We can say, at the present time, I think, rather confidently, that concentrations in the water in the range of 10 to 15 pptr in nanograms per liter are sufficient to cause the animals to exceed the 5 ppm maximum level as established by the Food and Drug Administration. This, then, I think, establishes the level to which we must regulate PCB's in the environment -- at least to that level.

As far as the results of the work to find out where they are coming from, as indicated in the report, the States have made surveys in various places and have, in fact, found sources of PCB's, particularly in industrialized areas, and in the grant work at Wisconsin, concentrations up into the hundreds -- at least over 100 ppm -- have been found in fish in tributaries where PCB's are commonly discharged.

The fish in the lake, as indicated in your report, are exceeding the 5 ppm maximum level, in many instances. While the final report is not in hand yet -- I should mention that these are conclusions which the author of that report has given me verbally -- the report shows that there is apparently not a great difference in the PCB concentration in fish from various parts of the lake. It shows that the larger fish have much more PCB's in them than the smaller fish, and this is thought to be related to the fat content of the larger fish; the larger fish having a higher fat content tend to have a higher PCB concentration. It all fits into the same pattern as we have seen with some of the chlorinated hydrocarbon pesticides.

I need not -- well, it is not within my expertise to talk about the policies that have been implemented either by the Federal Government or the State in terms of control of PCB's. But the committee is much concerned that while the domestic production and sale of PCB's has been curtailed substantially, we recognize, as far as the committee knows at least, there have been no controls instituted over the importation of foreign PCB's. Therefore, it is the committee's feeling that we dare not relax in the monitoring program for PCB's, both in terms of locating sources and inputs as well as the trend of concentration in the fish in the lake.

Because of the analytical difficulty of measuring PCB's, particularly in water of extremely low concentrations, it is the committee's feeling that these, too, should be watched through looking at residues in fish, and that this is a definite need in order to find out whether or not whatever controls the States and the Federal Government do institute on PCB's are effective.

Would you like me to go on to phthalates or pause for a minute on PCB's?

MR. MAYO: Let's stop here for a moment.

MR. PURDY: I have a comment with respect to the report, as presented, and that is that presently no State in the Lake Michigan Basin has regulations governing the discharge of PCB.

I wouldn't want to leave the impression that PCB's cannot be controlled with the existing legislation, although no specific regulation may have been adopted, that under the broad coverage of most water pollution control laws, that when a problem has been defined, that there is an avenue available to the States so that they can take action to correct that problem.

With respect to Michigan, under our critical materials that Michigan has established, polychlorinated biphenyls is a critical material that requires annual reporting, if you use it within your process.

Then, from the standpoint of no alternative to the use of a PCB, again, I wouldn't like to leave that stand in that there are hydraulic fluids available: phosphate esters, and combinations of phosphate esters and biphenyls, that can be used as a substitute. And wherever we now find polychlorinated products used as hydraulic fluids, whereby they can escape to the water environment, that we are requiring that these substitutes be used, and that the use of the polychlorinated biphenyls be phased out, period.

So I wouldn't like to leave those that use polychlorinated biphenyls with the idea that they can continue to use them because no regulation has been adopted. There is a way of getting a handle on it, and there are substitutes that they can use.

MR. MAYO: Dr. Mount, in your comments, you remarked that there has been restriction in the sale and use of domestically produced PCB's, but that there are no apparent constraints at the present time on the importation of PCB's from outside the United States.

Did the committee tend to come to any conclusion dealing with the urgency for national legislation to be drafted to control or at least account for the importation of materials such as PCB's?

DR. MOUNT: Well, not in the committee meeting, but in the meeting we held in Duluth this spring on PCB's, Dr. Buckley from R and M headquarters, told us that it was the feeling of headquarters that the Toxic Substances Control Act, I believe, which is in the process of being enacted or being voted on, would be applicable to such products as PCB's from foreign sources. Other than that, I know of no particular discussions about it.

MR. MAYO: Well, with that background on your part, to the extent that the Act will be applicable to materials such as PCB's, do you think there is some sense of urgency to proceed with the enactment of that kind of legislation?

DR. MOUNT: Yes, I think there definitely is.

MR. BRYSON: Dr. Mount, is the problem of analysis as evident to PCB's as it is in pesticides?

DR. MOUNT: Yes, I think the difficulty of analyzing for PCB's is even worse than DDT, but the concentrations in biological tissue are so high, and from what I can gather in talking with Dr. Stallings at Columbia, and some of the other chemists, the marriage of G. C. mass spectrophotometer and the computer software programs that go with it have made it such that the measurement or estimation of the quantity of PCB in tissues at the levels they occur at is precise enough for our need. After all, we are looking for concentrations up in the part per million range in the tissues.

This does not pose the difficulties of analytical measurement that are posed by measuring part per trillion concentrations in the water.

This, in fact, is in the same category and is the same reason why the committee, in 1968, recommended to this conference that the point of control be on the tissue rather than in the water.

There was another reason and that was we didn't know what water concentration was significant at that time and I guess that is still the case with DDT. I think we have a better control on DDT now in that regard. But in either event the organism is serving as a concentrated device in making the analysis more simple. It has the added advantage that what is in the organism you know as the biological activity is biologically inactive; whereas, measuring it in the environment you don't always know this.

MR. BRYSON: So that means, when you talk about "aquatic environment" on page 3 of your statement -- which reads: "The committee recommends to the Lake Michigan conferees that comprehensive surveillance by the States be initiated to determine PCB trends in the aquatic environment ..." — you are talking about the fish as opposed to water concentrations.

DR. MOUNT: Well, I think we are talking about the fish in the lake, but I think we are talking about effluents contributed to tributaries. It seems to me that this is the point of control or the point of finding out where to control by looking at their sources, and they are at high enough levels, generally speaking, in the waste effluents to be measured.

MR. McDONALD: What type of reduction, Dr. Mount, occurs, say, in an ordinary activated sludge sewage treatment plant?

DR. MOUNT: I have no knowledge of that, Mr.

McDonald.

MR. McDONALD: Do you have any knowledge or can you make any conjecture on levels of fish mortality that are fairly directly attributable to PCB's and DDT?

DR. MOUNT: As much as we know at the present time about the concentration of PCB's in Lake Michigan water and from what we know about the toxicity, about the only conjecture one can come to is that there should not be any direct toxicity or adverse effects.

Now the one point which is not clarified yet and for which we should have some reasonably good answers should have been this fall -- but because the animals didn't cooperate it is going to be next fall -- we will know, I think, whether or not PCB's are passed on in the eggs of fish and are absorbed at the time or are taken up at the time the yolk sac is absorbed and causes the mortality in the fry, much like has been ascribed to DDT. Now if that is happening, then my statement that there have not been direct adverse effects would not be true.

I should also mention that work recently by some people at Michigan -- and I believe some other workers, too -- has reasonably clearly shown that the failure of an increased production is most likely ascribable to PCB's and not to DDT or dieldrin.

MR. McDONALD: In terms of toxic substances that go into Lake Michigan, where would PCB's rate, in terms of mortality, in your judgment?

DR. MOUNT: In terms of mortality in the lake.

MR. McDONALD: Would it be number one on the list of toxic substances?

DR. MOUNT: No, I don't think it is number one.

MR. McDONALD: Where would it be relatively?

DR. MOUNT: Somewhere in the middle.

MR. McDONALD: Somewhere in the middle. What would rank ahead of it?

DR. MOUNT: I think this is too much conjecture really right now because we have very little knowledge of the organics that are going into that lake. There must be many of them. And whether they persist or not, I don't think we know. We know that there are a great many peaks that appear on the gas chromatograph, when one looks at sewage treatment plant effluent, and until we know what those are, there is no point in trying to decide which one is more important.

MR. McDONALD: So you are saying that you know there is a lot of PCB going in, but it is hard to pinpoint all of the effects.

DR. MOUNT: That is right.

MR. McDONALD: Thank you.

MR. MAYO: Mr. Purdy.

MR. PURDY: I would like to phrase that question in a somewhat different fashion. In view of the action level that has been established by the Food and Drug Administration on the public health aspect consumption of this as a food product, and in view of the relative magnitude of the concentrations of PCB's versus DDT, dieldrin, and so forth, and in view of the action that has already been taken to limit DDT input and dieldrin input into Lake Michigan, do you feel that the PCB is in the first priority of attention?

DR. MOUNT: I think that is a different question entirely because now we are asking the question: How is it important in terms of the residue that is there, from the human consumption point of view? And simply because many of the fish that have been analyzed in Lake Michigan are over that action level that by definition makes it a problem as far as the sale of those fish are concerned. And other than DDT and PCB's, I do not know offhand of another chemical which is exceeding an action level or a tolerance level that has been established -- well, I should mention dieldrin, too -- that is exceeding an action level established by the Food and Drug Administration.

On the other hand, I think it only fair to point out that action levels will not be established on these materials unless there is an indication of a problem or unless someone requests them, as I understand it.

MR. PURDY: But in view of what already has taken place -- and as I understand it, the PCB level is higher in fish than the DDT level -- that rather than wait for a monitoring program to indicate the trends of what is going to happen to the PCB levels, we ought to be taking some action today.

DR. MOUNT: That is exactly what I had tried to say and perhaps didn't do it well enough. I don't think we rest easy that the policies that we have in existence right now are going to do it without being certain that they will. And we believe we can do this by following what is in the fish and also the discharges, and proceed in taking whatever action is necessary based on the findings of that.

I think that also there is another advantage in following the trend of PCB's and DDT, for that matter, in Lake Michigan, and that relates back to Dr. Lee's comments of yesterday and his model of phosphorus.

We know very little about the purging rate of such material in the lake, and here is a case where we have a chance to find out what is going to happen, because we have a rather sudden shift off of the input of DDT and apparently we will have a substantial reduction, at least in PCB's, and this will make it much more possible to predict or understand how a material will disappear from the lake after the input is shut down. It will help in future problems.

MR. MAYO: Any other comments, gentlemen?

MR. FRANGOS: Yes, Mr. Chairman.

Just a comment, that we, in Wisconsin, have parallel legislation to that of Michigan with respect to surveillance and reporting, and that we are now in the process of developing rules and regulations and getting our program off the ground. But we also anticipate a more precise review of the use in the State of PCB's, also high on the list, and we will be requiring a reporting of the use and a materials balance analysis by those users.

Perhaps the question should go to you, Mr. Mayo, but I do recall that within the past several months that an Inter-Agency Federal report issued what might be called a policy statement on the use of PCB's.

Could you help us out on that? Are you familiar with that report or exactly what the purpose of that report was or what the report said?

MR. MAYO: Well, the purpose of the report, as an Inter-Agency Federal report, was to examine the extent to which PCB's exist in the environment, to try to recognize its importance as an economic chemical, and to suggest what actions might be desirable to control the further introduction of PCB's into the environment, what might be reasonable to expect to be the eventual fate of those PCB materials that were already in the environment.

I may reach back a little bit and try to recall what some of the principal conclusions of that report were. I think they went about like this: that the presence of PCB in the environment was more adequately established in the water environment than in the land environment; that its presence in fishes and in birds and small animals that rely on fishes for diet was pretty well established; that there was, at that point in time, no substantial evidence of the occurrence of PCB's in upland birds and animals that did not have a substantial reliance on fish or aquatic life for their diet. So that the presence of PCB in the environment seemed to be more importantly related to the water environment than the land environment.

Second, that the PCB materials had some fairly outstanding characteristics in industry that were not readily replaceable -- particularly with respect to certain electric components -- and that it would not be unreasonable to continue to use PCB's for those select purposes where there was virtually no opportunity for them to be introduced into the environment.

As I recall, the report also recommended that other uses of PCB's be discontinued. The report recognized that in the United States -- or at least in the northern hemisphere -- the northern half of the western hemisphere, the only production of PCB's was by Monsanto Chemical Company, and that Monsanto, by virtue of a sales policy, had restricted the sale of PCB's only to those users whose needs were rather specific to the unique properties of PCB materials, and for which there was no presently identified reasonable substitute.

It was mentioned that the PCB sales had been reduced dramatically by Monsanto since 1968 -- although I can't recall what the figures were. It also recognized that PCB's were being manufactured in Europe and Japan, that they will probably be manufactured in South America, and that, at this point in time, we have no adequate inventory of the extent to which PCB's were being imported into the United States, nor did we have any inventory of where those PCB's that might be imported were being distributed, or the extent to which they were being used, or the uses to which they were being put, and recommended the passage of the pending hazardous substances legislation currently before the Congress.

It also suggested that we had little choice, as far as the water environment is concerned, other than to rely on the slow degradability of the PCB's; that we should look toward a zero level of PCB's in industrial and municipal waste discharges, and that the -- as I recall -- action or that the level of control of PCB's in the water environment be somewhere in the neighborhood of either 0.01 or 0.001 ppb. I am reaching back to some of those numbers, but those were essentially the features of the report.

MR. FRANGOS: Thank you. That is a pretty good recall.

MR. MAYO: That was one of the few I read.

Any other questions, gentlemen? If not, we can move on to the other portion of your report, Dr. Mount.

MR. FETTEROLF: Just one question, Mr. Mayo.

You read us the recommendations that were in the report. Has EPA adopted those recommendations as a policy?

MR. MAYO: Well, the pending legislation is the key to the accomplishment of the recommendations that were contained in that report, and that is the issue that is presently before the Congress, and it perhaps would not be out of place for this conference to comment on the urgent need for the passage of that legislation.

MR. FETTEROLF: Well, at the present time, we see residues of PCB in fish in various areas, which the FDA has identified as being well above the action level, and I think it is certainly the responsibility of the conferees to push for this legislation so that a policy decision can come out of it of what action should be taken.

MR. MAYO: Just so long as we don't try to legislate against the extent to which fish can take up PCB's.

Any other questions on the PCB issue, gentlemen?

Would you proceed, Dr. Mount?

DR. MOUNT: Now, in regard to the phthalates, I think it was again in March of 1971, at this conference, that I mentioned that the occurrence of phthalates in Lake Michigan water -- and these were identified by the Fish Pesticide Research Laboratory in Columbia, Missouri, who were in the process of looking in detail at some of the water samples from Lake Michigan in connection with the pesticide work on DDT and dieldrin -- and they reported that there were higher concentrations of phthalates in the Lake Michigan open water than there were of DDT.

After the conference was over, I took the first opportunity, which came around in the next fiscal year, around the fall of 1971, and we wrote specifications for a contract, which was subsequently awarded for, I think, about $150,000 to look at the toxicity of phthalates on aquatic life because, again, we found ourselves in the same position with phthalates that we were several years ago with PCB's, and that was we had no notion of what concentration of phthalates was important --

MR. MAYO: Excuse me, Dr. Mount.

There is an awful lot of background noise from the audience, and I am confident some of the people in the rear are having difficulty hearing.

Please go on.

DR. MOUNT: We did not know what levels of phthalates to look for in a monitoring program and so we have initiated this work. I also had discussions with the Pesticide Laboratory in Columbia, Missouri and they quite willingly agreed to work with them in-house as well.

At the present time, we are still in the position of not knowing the levels that are harmful to various kinds of aquatic life except for Daphnia magna. That work was completed at Columbia by Dr. Schoettger's lab and they found that concentrations as low as 3 micrograms per liter -- which would be 3 ppb -- affected the growth and reproduction and death of the magna. That animal is very characteristically one of the most sensitive animals to the organic

D. Mount

chemicals, although one cannot generalize to everything from that one animal alone.

Our tests that will be concluded in the fall months of this year should give us a reasonably good idea of what levels of phthalates are going to be harmful to various types of aquatic life.

Again, I would remind all of us that the phthalates are not a single compound but a series of compounds, and some of them are chlorinated compounds, and it is highly likely, based on past experience, that some of them will be much more toxic than others.

There are several which constitute the major poundage of production in the United States, and these are included, and the work is being performed.

The information about the findings in the various States is all second-hand to me and perhaps the States themselves should comment on that. I would just call your attention to the statement at the top of page 6, which indicates that at least in Michigan some 36 treatment plants were sampled and they found 10 plants in excess of 10 ppb and 2 over 100 ppb, and I suppose that comparable concentrations have been found in other States or will be found.

The point I wish to make basically about concentrations is that the phthalates, unlike PCB's and DDT, have been found in concentrations in sewage treatment plants which are directly toxic to some forms of aquatic life, and I think this should add some degree of urgency in getting them up and finding out where they are coming from and how high they are.

As I have indicated, I think by Christmas we should have a fairly good handle on what level we ought to be looking for. In talking with Mr. Lueschow, who in turn talked to his chemist, it appears that the detection levels in the range of 0.05 micrograms per liter are not unreasonable levels to go for at all and it would appear that this ought to be low enough for our additional efforts in monitoring.

There is very little known about the mammalian toxicity of phthalates other than the acute toxicity and there it is very nominal.

There was a meeting on phthalates held in North Carolina and sponsored by the National Institute of Environmental Health scientists -- that was just last week, I believe. I had a representative from my staff there, and I have a number of the abstracts of papers that were given and the essence of it all is that it takes thousands of milligrams per kilogram to be acutely toxic to mammals. And this was a relatively nontoxic compound compared to some of the hydrocarbons, for example. This tells us nothing, however, about the toxicity to aquatic life and so we can make no extrapolations, at this time, about that.

Neither, as far as I know, is there much information about the persistence of phthalates in the aquatic environment or in any other environment. I think there is a feeling among some of the chemists I have talked with that they are likely to be less persistent than PCB's, but nevertheless their presence in some places certainly indicates that they last for some important period of time in the environment.

So I think this perhaps is not a very satisfying report as far as the conferees are concerned in terms of action, but I think we are well on our way now to having a better handle on what we ought to be doing.

I would also underline the last sentence on page 6 which indicates that the Food and Drug Administration -- and, by the way, we checked this again yesterday -- has not established any action levels on phthalates and so we have no guidance in that direction as we have had for DDT and PCB's.

MR. MAYO: Any comments or questions, gentlemen?

MR. BRYSON: As a result of the committee's work -- maybe I should direct the question to the States -- did any of the States initiate a program of monitoring of their sewage treatment plants?

MR. HERT: I would say Indiana has not, but I talked with our laboratory director who needs to get some more instrumentation in order to be able to do this, and he is proceeding to gear up to do analysis on wastewater treatment plants.

MR. PURDY: In Michigan, it is one of those critical materials upon which we receive reports of its usage. We have had a monitoring program to establish the fact that it is indeed reaching the environment. We are continuing that program, and we are now looking to see if the presence of phthalates in those places where we now find it is from a point source or from diffuse sources. And I am concerned, in this case, that once again, like DDT and dieldrin, that we are apt to find that due to the usage of the phthalates that it is from diffuse sources rather than from point sources, and that our ability to limit its entrance into the environment probably will be bent upon banning its use. And in view of its wide usage -- particularly in the plastic formulations -- and I don't know if there is a substitute -- it may be harder to ban its usage than it has been to ban the usage of DDT, dieldrin and PCB's.

DR. MOUNT: If I may comment to that point, not disagreeing with what you have said but, I guess, going a bit further -- I think it is very important that we not jump off of the deep end because we have found another organic chemical in the water; and neither do I believe that in every case banning a material is the answer to the problem because we may very well go to a chemical that is worse than the one we have banned. And we have every indication, at the present time, that the phthalates are not nearly as toxic as the PCB's, and the chlorinated hydrocarbons, and for this reason I think "caution" is the word, at this point. Certainly I think we should reduce the input of any foreign organic chemical where it is not a necessary input but, apart from that, I think we ought to be sure that we have a problem before we move too rapidly on this thing. That is why I think the first step is to find out what concentrations are there, and we are already finding out what concentrations are ecologically important.

There are a wide variety of uses of phthalates -- some extremely important ones in plasticizers -- and I think it would be foolish to move or to even talk about banning, at this point, until we know if we have a problem.

MR. SCHRAUFNAGEL: Wisconsin has checked about 25 municipal sewage treatment plants and finds that the range is from 2 to 4 ppb.

DR. MOUNT: One of the things that makes me feel that the phthalates may not be highly toxic to aquatic life is that in all of the aquatic laboratories -- such as my own and the one at Columbia, and other places -- we have been using plastic tubing and other types of plastic containers which the water flows through, and our fish are living in, and the leaching rate of the phthalates from the plants that get into the water is not a slow one at all and we have not experienced any trouble, which leads me to believe that they may not be particularly toxic to aquatic organisms. This is kind of "around-the-barn" reasoning but it is better than none, at this point, I guess.

MR. McDONALD: Don, would this be the reason why the cultured fish reflect higher levels than the natural fish?

DR. MOUNT: Yes, I think that is one. But I have talked with Dick Schoettger about that problem or that finding, and I think he feels that it is because of the handling of the food that they are eating, and I can't elaborate on it any further than that. But he believes the source is in the food the fish are eating rather than from the containers, and that sort of thing.

DR. KITCHEL: Dr. Mount, you mentioned a differential toxicity in chlorinated and nonchlorinated phthalates. Is there any indication that there is sufficient spread in this that we might be able to tolerate the non-chlorinated phthalates and eliminate the chlorinated phthalates?

DR. MOUNT: Well, I think that is a distinct possibility. Let me make certain though that I clarify the record to say that I only said that I suspect -- based on experience with other materials -- that there is likely to be a big difference, and further evidence of that is that I believe that it is one of the chlorinated phthalates that is used as an insecticide for apparently very limited application.

So, on that basis, I think that is highly probable, and I think it is also probable, based on our experience with some of the other herbicides, that the phthalic acid is going to be much less toxic than the esters of phthalic acid.

MR. PURDY: Mr. Mayo, with respect to the recommendation of the committee that the conferees request the Federal Food and Drug Administration to further evaluate the problem and determine whether an action level for fish needs to be set, I am in agreement with that; but, in addition to that I think the conferees should also ask that EPA continue its work and do whatever is necessary to evaluate the ecological significance of the phthalate discharge to our surface waters and see if an action program is necessary.

DR. MOUNT: Mr. Chairman, before you respond to Mr. Purdy's question, might I correct the statement that I made just a minute or so ago. That chlorophthalate I was referring to is used in herbicides rather than insecticides.

MR. MAYO: I think that would not be an unreasonable recommendation for the conferees to come to and ought to be part of the business of the Executive Session.

Are there any other questions or comments to be directed to Dr. Mount?

Thank you, Dr. Mount.

MR. BRYSON: The final section of the Pesticide Committee will be a report on heavy metals, and this will be presented by Mr. Fetterolf.

STATEMENT OF CARLOS FETTEROLF,
CHIEF ENVIRONMENTAL SCIENTIST,
MICHIGAN WATER RESOURCES COMMISSION,
LANSING, MICHIGAN

MR. FETTEROLF: Mr. Chairman, conferees, ladies and gentlemen.

As Mr. Lueschow told you, the Lake Michigan Interstate Pesticide Committee was created in 1968. Its responsibilities have been considerably broadened by the charges of the conferees, and it is now functioning really as a toxic substances advisory body.

This report deals with selected trace metals which may be of biological significance in Lake Michigan.

Scientists have been studying the effects of these metals on aquatic ecosystems for many years. While some of the committee members have been deeply involved in such studies on a local basis, we have discovered that it was becoming increasingly clear that no one was looking at the general situation with respect to metals in Lake Michigan.

With this question in mind, the committee asked each State member in 1971 to submit selected trace metal data for Lake Michigan and its tributaries. These data submissions comprise this report.

Basically the report is concerned with the existing knowledge of selected trace metals in the water, sediments, and aquatic life resources of Lake Michigan and its tributaries. Some information is also presented on the sources of these metals from industries, municipal sewage treatment plants, and atmosphere and fallout.

It will be obvious to the reader that more information is needed.

In addition, the committee included a synopsis of much literature on selected trace metals. The committee believes that this report is sufficiently representative of existing knowledge that it warrants the conclusions and recommendations drawn.

The metals selected are those which may, even at very low concentrations, cause problems to aquatic life or humans.

Although data are available from many different sources, no attempt is presently being made to monitor the overall conditions within the Lake Michigan Basin. Little is known about the sources and amounts of metals now entering the lake. For example, airborne emissions from powerplants, steel mills, and incinerators may be contributing significant amounts of some metals to the lake environment. More study should be encouraged so that reliable estimates can be made and the true significance of airborne emissions established.

While data are available on water concentrations of heavy metals in Lake Michigan and its tributaries, the levels of sensitivity and number and frequency of samples are inadequate to establish present conditions and contributions. Zinc occurs in high enough concentrations so that it is detectable using present analytical techniques. Copper, cadmium, nickel, lead and chromium, are generally below detectability in Lake Michigan. Heavy metals in both Indiana and Michigan tributaries are often below the level of detectability, and little information is available from Wisconsin tributaries.

Recent data indicate that the Grant River may be a significant source of copper, nickel, chromium, and zinc to the southern basin of the lake.

Generally, however, analytical sensitivities for metals in water samples must be improved before any meaningful conclusions about the actual heavy metals concentration in Lake Michigan and the contribution of the tributaries to these levels can be established. Furthermore, tributaries must be sampled at various flow stages to enable an estimate of sources and mass balance to be made. It is imperative that sufficient data be obtained to determine if metals concentration in Lake Michigan is increasing in order to predict whether harmful levels are likely to be reached given present input levels.

Heavy metals usually are found in sediments at much higher concentrations than in the overlying water, but adequate information is lacking as to the ecological significance of these accumulations in varied environments.

Metals in sediments are potentially available for uptake by some organisms and may accumulate through the aquatic food chain. Since the information available does not permit us to reliably predict whether or not various metals will be reconcentrated in aquatic organisms from bottom sediments, such deposits must be viewed with concern.

The data indicate that mercury, lead, zinc, chromium, copper, and arsenic are accumulating in the uppermost sediments of the deeper regions of southern Lake Michigan. These uppermost sediments, of course, are the most recently deposited ones. The trace elements which show little or no accumulations in the top layers of sediment are boron, cobalt, beryllium, lanthanum, manganese, nickel, scandium, and vanadium. Significant areas of concentration of chromium, mercury, arsenic, copper, lead, and zinc occur off Grand Haven and Benton Harbor in Michigan; off Waukegan in Illinois; and in the center of the lake near the Illinois-Wisconsin border.

Studies by the Illinois Geological Survey show a good correlation with organic carbon distribution in sediments and concentrations of certain elements. These correlations suggest that elevated levels of certain metals in top sediments are the result of man's recent activities in the watershed surrounding Lake Michigan and perhaps are related to increased biological productivity.

Further studies of metals in sediments by the State of Michigan and the U.S. Geological Survey have clearly established that municipal and industrial discharges are important sources of metals.

Not enough is known about heavy metals in tributary sediments and their movements to calculate a poundage input of heavy metals to Lake Michigan from sediments. Since the significance of metals in sediments is unknown, monitoring of stream and lake sediments is necessary to locate contaminated areas and sources of heavy metals to the Lake Michigan ecosystem. The existing potential "hot spots" should be watched carefully for problems such as the one which developed over the methylation of mercury in sediments by bacteria. The sources of heavy metals should be controlled so further deposition is eliminated or decreased.

It appears that except for mercury, metal residues in fish do not exceed concentrations that are likely to be selected if Food and Drug Administration action levels were to be established.

Data on the acute toxicity of metals, using Lake Michigan water and fish, are not available. However, it is possible to estimate the probable safe ranges using existing bioassay data to estimate the 96-hour TLm values for Lake Michigan fish and water.

Estimates of probable safe ranges for Lake Michigan fish are given for copper, nickel, zinc, cadmium, and chromium. Estimates of probable safe concentrations for other metals must be based on 1/100 of the 96-hour TLm until data are available upon which better predictions can be made.

The committee's recommendations:

1. There is an urgent need to establish acute toxicity levels for selected metals using Lake Michigan water and various life stages of Lake Michigan fish. Such information will make it possible to establish recommended safe levels for selected metals in Lake Michigan. Until this information is available, we must use available bioassay data from the literature to establish probable safe ranges.

2. The States should report regularly on the inputs of metals to the Lake Michigan Basin, based on information obtained from industrial permit programs and tributary monitoring. Sewage treatment plant effluent should also be monitored to determine the input of metals from this source.

3. Analytical and field methods must be standardized for all heavy metals research programs to insure the

data obtained are accurate and precise and contribute to the body of comparable data. The Interstate Pesticide Committee has taken a step toward resolving this problem by having a meeting on August 23 and 24 of the working chemists from agencies represented on the committee.

4. An attempt should be made to determine the contribution of airborne emissions of metals to the waters of Lake Michigan and its tributaries.

5. While the committee feels that the present levels of selected trace metals are not a problem at this time, the Food and Drug Administration guidance should be obtained to establish acceptable levels of these metals in fish.

6. Levels of selected trace metals in Lake Michigan waters and fish should be clearly established at this time. A program to monitor changes in these levels and to establish future trends is also needed. This, of course, can be tied in with the pesticide and PCB monitoring programs.

7. An effort should be made to understand the ecological significance of metals in sediments. The potential impact of such compounds as NTA, one proposed substitute for phosphorus in detergents, of the metal deposit in sediments should also be explored.

That concludes our report, Mr. Chairman.

(The complete "Report on Selected Trace Metals in the Lake Michigan Basin" by the Lake Michigan Enforcement Conference Pesticides Technical Committee is on file at EPA, Headquarters, Washington, D.C., and EPA Region V Office, Chicago, Illinois.)

MR. BRYSON: The next item on the agenda is the Chloride Report. At the last session of the conference, the conferees entered into a discussion on the question of chloride dischargers into Lake Michigan. As a result of that discussion, they concluded and recommended the following:

"The States will provide to the conferees a listing of all identifiable chloride sources of significance in the conference area. The Federal conferee, after consultation with the States on measures for control of chlorides, will make a proposal for chloride control at the next conference session. The Federal conferee will also provide to the conferees a State-by-State resume of the water quality standards on chlorides. This report will also show the relationship of the standards to the existing water quality."

EPA has concluded its report in response to this conference recommendation.

At this point, I will call on Mr. Gary Schenzel to present that report to the conferees. Mr. Schenzel.

STATEMENT OF GARY SCHENZEL,
U.S. ENVIRONMENTAL PROTECTION AGENCY,
ENFORCEMENT DIVISION,
CHICAGO, ILLINOIS

MR. SCHENZEL: Thank you, Mr. Bryson.

My name is Gary Schenzel, U.S. EPA, Enforcement Division, Chicago.

I have prepared a brief overview of the chloride issue for presentation today; however, I request that a copy of the full chloride report be placed into the record.

(The document above referred to follows in its entirety.)

REPORT OF
THE ENVIRONMENTAL PROTECTION AGENCY
TO
THE LAKE MICHIGAN ENFORCEMENT CONFERENCE
ON
CHLORIDE

SEPTEMBER 1972

The third session of the Lake Michigan Enforcement Conference asked the State Conferees to submit a list of all significant, identifiable chloride sources in the Basin, along with ideas for chloride control. The Federal Conferee was requested to provide a resume of State chloride standards, an estimate of the present chloride level in the Lake and, in cooperation with the States, proposals for chloride control at the fourth conference session.

A major reason for urging control of chloride discharges is to help limit the build-up of Total Dissolved Solids (TDS) in Lake Michigan. The Great Lakes Water Quality Agreement recently signed by Canadian and U. S. officials requires the control of TDS to help protect the aquatic environment of the International Great Lakes from further degradation. In compliance with this agreement, and to maintain existing TDS levels in Lake Michigan, the control of chloride is not only desirable, but mandatory.

The strategy underlying the Conference discussion and recommendations was to control large point sources of chloride discharge rather than to initiate a comprehensive program to limit all point and diffuse sources. The conferees identified two major areas in the Lake Michigan basin which have large point sources of chloride. These were the Manistee-Ludington area in western Michigan, and the Calumet area in Indiana.

This report follows the direction set by the conference. It concentrates on the State efforts to control large sources of chloride, summarizes existing chloride levels in the Lake, relates water quality standards and the existing water quality, and identifies measures to further control chloride discharges.

RELATIVE IMPORTANCE OF THE CHLORIDE PROBLEM

The chloride concentration in nearly all areas of Lake Michigan is not high enough now to seriously interfere with water use. Nor will the level increase greatly in the next fifty years to become a major water quality problem. In 1965, Ownbey and Willeke[1] reported the average chloride concentration to be 7 mg/l, predicting an increase to 12 mg/l by the year 2020, based on projected growth in population and industry in the basin. The authors concluded that this slow rate of chloride build-up was not a threat to the Lake water quality. However, noting a major contribution from the salt producing companies in western Michigan, they suggested control of these sources if a chloride discharge reduction became necessary.

A more recent paper by O'Connor and Mueller[2], which is based in part on the Ownbey data, presented a chloride model for all of the Great Lakes. It too predicts a slow increase in chloride concentration in Lake Michigan. In addition, the O'Connor model semi-quanitatively predicts the effect on water quality of reducing industrial chloride loadings. This study reported that complete control of industrial loadings would reduce the chloride concentrations by 1 mg/l by the year 2020.

Since chloride is a conservative material, it is not degraded once it enters the Lake. The only removal process is to allow it to flow naturally to the lower Great Lakes. The large volume in relationship to the tributary inflow gives Lake Michigan a detention time of nearly 100 years. Control measures, therefore, would not show

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effects for a significantly long period of time. Because of these facts, it is better to keep chloride out of the Lake rather than apply control measures after the concentration has become too high.

If recent sampling data is representative of a trend in chloride concentration, then the rate of chloride increase in Lake Michigan is more rapid than predicted by Ownbey. Rather than the 7.5 mg/l level predicted for 1970, the concentration in that year, by actual survey, was close to 10 mg/l. It is the conservative nature of chloride, along with the long detention time for the Lake that makes this more rapid increase subject to concern.

TOTAL DISSOLVED SOLIDS & CHLORIDE CONTROL

Chloride is important since it is a major component of Total Dissolved Solids (TDS) from man-made sources. In addition, chloride serves as an indicator for TDS control. Reduction of chloride from large point sources would also reduce other ions which are part of TDS.

Historically, levels of TDS in the lower Great Lakes have climbed rapidly. In 1920 the level was 145 mg/l in Lake Erie. The level had reached 185 mg/l by 1960[3]. A somewhat similar increase has been observed in Lake Michigan. In the 90 years between 1870 and 1960, the TDS level there rose 30 mg/l to its present level of 160 mg/l [4].

The United States and Canada have long been concerned with deteriorating water quality in the International boundary waters of the Great Lakes. Recently, the two countries signed the "Great Lakes Water Quality Agreement" which defines water quality objectives to protect and upgrade the water. In signing this Agreement, both countries recognized the need to limit the build-up of TDS. Control of chloride in Lake Michigan, which is a tributary to Lake Huron, is an important part of fulfilling the Agreement, since annex 1, section 1(c) limits the level of TDS in Lake Huron to current levels pending further study.

CHLORIDE SOURCES IN THE LAKE MICHIGAN BASIN

The conference requested the States to provide a listing of all identifiable chloride sources of significance in the Lake Michigan basin. The information supplied in response to that request is given in Table A. A discussion of the information follows:

Wisconsin

Wisconsin submitted information on chloride concentrations in major tributaries of the State within the Lake Michigan drainage basin for the winter months (December to March, 1969 water year). From this data, EPA has calculated the approximate yearly loading to the Lake from these tributaries. Since only the winter chloride concentrations and tributary flows were available, the calculated loading is actually the total for only four months. Because the four-month loading is used as the approximate yearly load, the latter figures are probably underestimates. The Fox River is by far the largest tributary source from Wisconsin to Lake Michigan. The greatest input to the River is in the lower Fox region.

Illinois

The minor chloride point sources in the Illinois portion of the Lake Michigan drainage basin do not need immediate control.

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TABLE A

WISCONSIN

Tributary	Mean Conc. (mg/l)	Mean Flow Dec. to Mar. (cfs)	Approximate Loading (#/year)
Fox			
Green Bay	13.6	4741	106 X 10^6
Omro	5.1	-	
Milwaukee			
Machinery Bay	49.5	330	32 X 10^6
Brown Deer	37.5	-	-
Root	77.3	143	18 X 10^6
Other Wisc. Rivers	-	-	40 X 10^6
Subtotal			196 X 10^6

ILLINOIS

Tributary or Source	Mean Conc. (mg/l)	Mean Flow (mgd)	Loading (#/year)
Pettibone Creek	54	2.0	0.33 X 10^6
Domestic Waste Water	10	40.0	1.2 X 10^6
Abbott Labs	25	15.0	1.1 X 10^6
U.S. Steel (Waukegan)	-	5.6	2.0 X 10^6
Subtotal			4.6 X 10^6

MICHIGAN

Source	Flow (mgd)	Maximum Loading (#/day)	Loading (#/year)
Loading from Tribs. (includes indirect point sources)	12,000		1,004 X 10^6
Indirect Point Sources to Lake			
Dow Chemical (Ludington)		0.088 X 10^6	
Morton Salt & Chem. (Manistee)		0.237 X 10^6	
Hardy Salt (Manistee)		0.12 X 10^6	
Hooker Chemical (Montague)		0.221 X 10^6	
Std. Lime and Ref (Manistee)		0.50 X 10^6	
Direct Point Sources			
Dow Chemical (Ludington)		1.97 X 10^6	719 X 10^6
Std. Lime & Ref. (Manistee)		1.00 X 10^6	365 X 10^6
Subtotals		4.136 X 10^6	2,088 X 10^6

INDIANA

Source	Loading (lbs/ year)
Bethlehem Steel (Chesterton)	6.79 X 10^6
Atlantic Richfield (East Chicago)	4.31 X 10^6
American Oil Co. (Whiting)	5.52 X 10^6
Youngstown Sheet & Tube (East Chicago)	47.54 X 10^6
U. S. Steel (Gary)	28.08 X 10^6
Inland Steel (East Chicago)	39.49 X 10^6
Subtotals	131.73 X 10^6

TOTAL CHLORIDE LOADING TO LAKE MICHIGAN 2,421 X 10^6

Michigan

Michigan reported direct and indirect point sources plus the average loading from its tributaries to the Lake. To calculate the total yearly load, the amounts of chloride from the direct point sources and tributaries were added together. Since the loading figures for the point sources were maximum values, the yearly loading total may be an over-estimate. On the basis of the figures given in Table A, the Michigan point sources contribute about 40% of the total chloride loading to the Lake. However, those figures show the loading situation as of June 1971. Since that time, Michigan has started an extensive control program. The details of this program will be discussed in detail later, but its results are summarized in Table D.

Indiana

There are some significant point sources from Indiana. Several steel companies have, in the past few years, controlled chloride discharges by deep well injection of chloride containing pickling acid. The figures in Table A reflect the effects of this control. However, EPA believes that further control is desirable.

Total Chloride Loading to Lake Michigan

The total chloride loading to the Lake is approximately 2,400 x 10^6 lbs/year, with the most important loadings coming from the brine area in western Michigan. This total over-estimates the contribution made by the brine industries, but under-estimates the amount of background rural and urban runoff.

The loading figure is more than twice that used by Ownbey. According to his figures, of the total of 1,191 x 10^6 lbs/year, 660 x 10^6 lbs/year came from industrial sources. In contrast to his estimate, the data supplied by Michigan show that until recently two industrial sources discharged 1,084 x 10^6 lbs/year. Clearly, the projections made in 1965 under-estimated the effect of industrial discharges.

WATER QUALITY STANDARDS AND THE AMBIENT LAKE QUALITY

Table B summarizes the current Federal-State water quality standards for chlorides in Lake Michigan.

TABLE B

STATE	CHLORIDE WATER QUALITY CRITERIA
Illinois	Shall not exceed 12.0 mg/l
Indiana	
(Lake Michigan)	Single value shall not exceed 15 mg/l Monthly average shall not exceed 10 mg/l
(Inner Harbor)	Single value shall not exceed 30 mg/l Monthly average shall not exceed 20 mg/l
Michigan	Desirable monthly average shall not exceed 10 mg/l Permissible monthly average shall not exceed 50 mg/l (measured at public water supply intake)
Wisconsin	No standard designed to limit Chloride. (Wisconsin does use the PHS drinking water standard of shall not exceed 250 mg/l in the drinking water supply after treatment.)

In addition to the numerical criteria summarized above, all four States have anti-degradation statements which require water quality to be maintained at existing levels.

For the purpose of comparison, EPA has assembled recent data on the ambient chloride level in Lake Michigan (Table C). Extreme values from stations near the Manistee-Ludington area of Michigan have been omitted.

TABLE C

SOURCE OF DATA	GROSS MEAN CHLORIDE CONCENTRATION	RANGE OF VALUES
Ownbey (1965)[1]	7	---
Envir. Research Groups (1969-70)[5]	11	9 - 15
FWQA (1970)[6]	9.8	8 - 15
Milwaukee Water Intake (1971)	8.4	7 - 11
Chicago Water Intake (1971)	9.6	7 - 13

The values listed in Table C indicate that the chloride level in Lake Michigan is increasing faster than had been anticipated. For example, Ownbey believed the Lake chloride concentration would not reach 9.6 mg/l until year 2000. Based on the data reported here, the concentration may already be close to, or greater than that value.

The major rationale for limiting chloride discharges is a desire to keep down the level of a potentially serious pollutant. The antidegradation statements in the Federal-State standards serve as a basis for this course of action. However, given a large number of small man-made sources combined with an existing background from land run-off, the chloride level in Lake Michigan will continue to rise. The numerical criteria should be set at a chloride level near to that existing in the Lake. They should be close enough to be criteria with meaning, but far enough above the actual concentration to allow for an inevitable yet acceptable rate of increase.

EPA believes the chloride criteria for the States of Michigan and particularly Wisconsin are set too far above the existing concentration. These values should be set closer to the existing quality and more in line with other State criteria.

CURRENT ABATEMENT EFFORTS

Since January 1971, the State of Michigan has signed stipulations with the major salt and chemical industries in the Manistee-Ludington area. Company action in compliance with these agreements has achieved the following results:

Hardy Salt Company - Manistee

The Company has completed facilities to recover all brine from backwashing the brine wells. The discharge of chlorides and solids from the thickner has been eliminated utilizing a closed settling and recycling system. Also, facilities have been completed for recovering the wet salt for process reuse. The facilities for completing the final stage of the program were held up this spring. However, completion is expected by October 1, 1972. Present chloride discharge in excess of State stipulation is to a closed lagoon system. These wastes will be disposed after deep well injection facilities are completed in October. Total chloride loading then will be 30,000 lbs/day.

Morton Salt Company - Manistee

Injection system is now completed, but lack of operating data makes it difficult to determine current loading. Prior to operation of the injection system the load was 19,000 lbs/day as a result of other control measures. The state limit is an average of 12,000 lbs/day and 18,000 lbs/day maximum.

Morton Chemical Company - Manistee

Construction was to be completed by June 1, 1972. However, due to delays in equipment delivery and obtaining building permits, the Company now expects the completion of the facilities by September 1, 1972. The maximum chloride loading after that date will be 22,800 lbs/day. Currently the discharge is 40,000 lbs/day.

Standard Lime and Refractory - Manistee

Construction of the Phase I facilities is underway and is expected to be completed by the September 1, 1972 date contained in the Stipulation - the loading then will be 1,127,000 lbs/day. Phase II of the program which will reduce the chloride discharges loading to 307,600 lbs/day is scheduled for completion by December 1, 1973. Present loading is 1,870,000 lbs/day.

Dow Chemical Company - Ludington

Construction of the piping arrangements and deep disposal well is underway with completion expected by the December 1, 1972 required date. The discharge is now about 30 to 40 thousand lbs/day into Pere Marquette Lake, and 600 to 700 thousand lbs/day into Lake Michigan. After December 1972, the total load will be limited to 380,000 lbs/day.

Hooker Chemical Company - Montague

The Company has submitted and received approval of their preliminary engineering report. Work on the plans and specifications is progressing with submission of such expected by the required December 1, 1972 data. Completion is scheduled for September 1, 1973. The loading at that time will be 52,650 lbs/day.

The substantial reduction in loadings is summarized in Table D. Overall, the chloride discharge for this group of industries on January 1, 1973 will be only 40% of the discharge as of June 1971.

TABLE D

PROGRESS IN CONTROLLING MICHIGAN
POINT SOURCES OF CHLORIDE

Source	Peak Loading as of June 1971 (lbs/day)	Present Estimated Loading (lbs/day)	Planned Loading Required by State (lbs/day)
Hardy Salt	120,000	30,000	30,000 max.
Morton Salt	12,000	12,000 ave. 19,000 max.	12,000 ave. 18,000 max.
Morton Chemical	50,000	40,000	22,800 max.
Morton Salt and Chemical-Combined Discharge	175,000	---	Above Limits Include this discharge
Standard Lime and Refractory	1,500,000	1,870,000	1,127,000 by Sept. '72 307,600 by Dec. '73
Dow Chemical	88,000 To Pere Marquette Lake	40,000	380,000 max.
	1,970,000 To Lake Michigan	700,000	
Hooker Chemical	221,000	221,000	52,650 max.

POSSIBLE METHODS OF CHLORIDE CONTROL

From Industrial Sources: Since a few large industries contributed so much to the chloride problem, they were a logical choice on which to focus for control. Primarily through in-plant controls, recycling of process water and a different location for the ultimate disposal chloride, these industries will have achieved about 60 percent reduction in chloride load to the Lake between January 1971 and June 1973. This reduction is in addition to some control negotiated between the industries and Michigan prior to 1971.

Other industries can use similar methods of control. However, because of increasing demands for better wastewater treatment, chloride loadings may increase even with efforts to control them. Physical-chemical methods of treatment increase chloride levels during treatment in return for lower levels of more serious pollutants. There is a trade-off between good control of these more important pollution parameters and higher levels of chloride and other dissolved solids.

From Run-off: Another major cultural source of chloride is that amount added to urban run-off through the use of highway de-icing salt. Data supplied by Wisconsin indicates that the mean chloride concentration in a river as it passes through an urban area may double due to run-off containing the salt. However, there are no basin-wide estimates of the chloride concentration in urban run-off.

Control of chloride in urban run-off seems to be a matter of metering salt application to limit the amount applied to the minimum necessary to de-ice the streets. Salt stockpiles may be centralized to reduce the number of sites. The salt pile can be protected from rainwater

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and surface drainage. Retention basins can collect concentrated brine that does manage to leave the salt loading areas.

While urban run-off may be a major source of chloride, storm water treatment methods now being studied for use in controlling BOD and nutrients probably should not be designed specifically to include chloride treatment. The effects of BOD and nutrients are much more serious than those of chloride. Since chloride is not biologically degradable or removed from water by geological processes, it is more logical to control its discharge by handling and use regulations rather than through water treatment.

Ultimate Disposal: Ultimate disposal of chlorides remains a problem. Even if brine waste is concentrated to reduce the volume of waste, unless there is in-plant recovery the same amount of chloride is left. Presently, deep well injection is being used for the brine wastes in western Michigan. While EPA does not approve of deep well injection as a generally acceptable method of ultimate disposal, in this case returning the salt to a brine field area seems acceptable since there have been assurances that underground contamination of existing fresh water supplies will not occur.

SUMMARY

The chloride level in Lake Michigan is not high enough at present to interfere with use of the water. Although the rate of increase in concentration appears to be more rapid than was previously predicted, specific control of chlorides should generally be limited to the large industrial sources, and to whatever extent possible, de-icing salt in urban run-off.

After Michigan industries are brought into compliance with State stipulations, EPA believes there will be significant improvement in water quality near the points of discharge. However, the numerical criteria for the States of Michigan and particularly Wisconsin are substantially less restrictive than existing water quality. These criteria should be lowered to bring them more in line with those of the other States. The antidegradation statements included in the Federal-State standards do serve to protect existing water quality.

Michigan, the State with the most significant chloride point sources, has made a good effort at controlling these sources. The average reduction in chloride discharge is expected to be 60% for the period between January, 1971 and January, 1973.

Urban run-off, industrial waste, and waste treatment processes continue to be most important sources of chloride. Certainly excess applications of de-icing salt should be eliminated and better controls initiated to protect against slug loads to receiving waters during wet weather from salt storage. Large industiral sources may have to provide

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further treatment to remove chloride and TDS, and to this extent, should be evaluated at a later date to determine if additional controls will be necessary.

Control of chloride discharges in Lake Michigan is one of the best methods available to limit the increase in TDS to protect the water quality of the International Great Lakes.

NOTES

1. Ownbey, C.R. and Willeke, Q.E., "Long Term Solids Build-up in Lake Michigan Water." Pub. No. 13, Great Lakes Research Division, the University of Michigan, 1965.

2. O'Connor, D.J., and Mueller, J.A., "A Water Quality Model of Chlorides in Great Lakes." J. Am. Soc. Civ. Eng., San. Eng. Div., SA 4, Aug. 1970 p. 955.

3. Lake Erie Report, U.S. Dept. of Interior, Federal Water Pollution Control Agency, Aug. 1968, p. 33.

4. Beeton, A.M., "Eutrophication of the Laurentian Great Lakes", The University of Wisconsin Magazine Fall, 1970.

5. Copeland, R.H., and Ayers, J.C., "Trace Elements Distributions in Water," Report by the Environmental Research Group, Inc. May 1972.

6. Federal Water Quality Administration, Lake Michigan Open Lake Cruise, Summer 1970.

MR. SCHENZEL: The third session of the Lake Michigan Enforcement Conference asked the State conferees to submit a list of all significant, identifiable chloride sources in the basin, along with ideas for chloride control. The Federal conferee was requested to provide a resume of State chloride standards, an estimate of the present chloride level in the lake and, in cooperation with the States, proposals for chloride control at the fourth conference session.

This report followed the direction set by the conference.

RELATIVE IMPORTANCE OF THE CHLORIDE PROBLEM

The chloride concentration in nearly all areas of Lake Michigan is not high enough now to seriously interfere with water use. In 1965, Ownbey and Willeke reported the average chloride concentration to be 7 mg/l, predicting an increase to 12 mg/l by the year 2020.

If recent sampling data is representative of a trend in chloride concentration, then the rate of chloride increase in Lake Michigan is more rapid than predicted by Ownbey. Rather than the 7.5 mg/l level predicted for 1970, the concentration in that year, by actual survey, was close to 10 mg/l. It is the conservative nature of chloride, along with the long detention time for the lake that makes this more rapid increase subject to our concern here today.

TOTAL DISSOLVED SOLIDS AND CHLORIDE CONTROL

Chloride is important since it is a major component of total dissolved solids (TDS) from man-made sources. In addition, chloride serves as an indicator for TDS control. Reduction of chloride from large point sources would also reduce other ions which are part of TDS.

The United States and Canada have long been concerned with deteriorating water quality in the international boundary waters of the Great Lakes. Recently, the two countries signed the "Great Lakes Water Quality Agreement" which defines water quality objectives to protect and upgrade the water. In signing this agreement, both countries recognized the need to limit the buildup of TDS.

CHLORIDE SOURCES IN THE LAKE MICHIGAN BASIN

The conference requested the States to provide a listing of all identifiable chloride sources of significance in the Lake Michigan Basin. A discussion of this information follows:

Wisconsin

Wisconsin submitted information on chloride concentrations in major tributaries of the State within the Lake Michigan drainage basin for the winter months (December to March, 1969 water year). From this data, EPA has calculated the approximate yearly loading to the lake from these tributaries. The Fox River is by far the largest tributary source from Wisconsin to Lake Michigan.

Illinois

The relatively minor chloride point sources in the Illinois portion of the Lake Michigan drainage basin do not appear to need immediate control from a chloride reduction standpoint.

Michigan

Michigan reported direct and indirect point sources plus the average loading from its tributaries to the lake. On the basis of the figures given, the Michigan point sources contribute over 80 percent of the total chloride loading to the lake as of June 1971. I would point out that this is a correction from some of the copies that you may have. Since that time, Michigan has started an extensive control program.

Indiana

There are some significant point sources from Indiana. Several steel companies have, in the past few years, controlled chloride discharges by deep well injection of chloride containing pickling acid. However, the EPA believes that further control is desirable.

TOTAL CHLORIDE LOADING TO LAKE MICHIGAN

The total chloride loading to the lake is approximately 2.4 billion pounds/year, with the most important loadings coming from the brine area in western Michigan.

The loading figure is more than twice that used by Ownbey. Clearly, the projections made in 1965 underestimated the effect of industrial discharges.

WATER QUALITY STANDARDS AND THE AMBIENT LAKE QUALITY

TABLE B

The following is a listing of chloride standards, State-by-State:

STATE	CHLORIDE WATER QUALITY CRITERIA
Illinois	Shall not exceed 12.0 mg/l.
Indiana (Lake Michigan)	Single value shall not exceed 15 mg/l. Monthly average shall not exceed 10 mg/l.
(Inner Harbor)	Single value shall not exceed 30 mg/l. Monthly average shall not exceed 20 mg/l.
Michigan	Desirable monthly average shall not exceed 10 mg/l. Permissible monthly average shall not exceed 50 mg/l (measured at public water supply intake).
Wisconsin	No standard designed to limit chloride. (Wisconsin does use the PHS drinking water standard of "shall not exceed 250 mg/l in the drinking water supply after treatment.")

All four States have antidegradation statements which require water quality to be maintained at existing levels.

The present lake values also indicate that the chloride level in Lake Michigan is increasing faster than had been anticipated.

The major rationale for limiting chloride discharges is a desire to keep down the level of a potentially serious pollutant. The numerical water quality standard criteria should be set at a level near to the existing chloride level in the lake.

EPA believes the chloride criteria for the States of Michigan and particularly Wisconsin are set too far above the existing concentration.

POSSIBLE METHODS OF CHLORIDE CONTROL

From Industrial Sources: Since a few large Michigan industries contributed so much to the chloride problem, they were a logical choice on which to focus for control. Primarily through in-plant controls, recycling of process water and a different location for the ultimate disposal of chloride, these industries will have achieved about 60 percent reduction in chloride load to the lake between January 1971 and June 1973.

From Runoff: Another major cultural source of chloride is that amount added to urban runoff through the use of highway de-icing salt. Data supplied by Wisconsin indicates that the mean chloride concentration in a river as it passes through an urban area may double due to runoff containing the salt.

Control of chloride in urban runoff seems to be a matter of metering salt application to limit the amount applied to the minimum necessary to de-ice the streets. Salt stockpiles may be centralized to reduce the number of sites. The salt pile can be protected from rainwater and surface drainage. Retention basins can collect concentrated brine that does manage to leave the salt loading areas.

Ultimate Disposal: Ultimate disposal of chlorides remains a difficult problem. Presently, deep well injection is being used for the brine wastes in western Michigan. While EPA does not approve of deep well injection as a generally acceptable method of ultimate disposal, in this case, returning the salt to a brine field area seems acceptable, since there have been assurances that underground and surface contamination of existing freshwater supplies will not occur.

Let me summarize this report by reiterating some of its findings and conclusions.

The chloride level in Lake Michigan is not high enough at present to interfere with use of the water. Although the rate of increase in concentration appears to be more rapid than was previously predicted, specific control of chlorides should generally be limited to the large industrial sources, and to whatever extent possible, de-icing salt in urban runoff.

After Michigan industries are brought into compliance with State stipulations, EPA believes there will be significant improvement in water quality near the points of discharge. However, the numerical criteria for the States of Michigan, and particularly Wisconsin, are substantially less restrictive than existing water quality. These criteria should be lowered to bring them more in line with those of the other States. The antidegradation statements included in the Federal-State standards do serve to protect existing water quality, but tightening numerical criteria is necessary to meet the intent of the antidegradation clause.

Michigan, the State with the most significant chloride point sources, has made a good effort at controlling these sources. The average reduction in chloride discharge is expected to be 60 percent for the period between January 1971 and January 1973.

Urban runoff, industrial waste and waste treatment processes continue to be most important sources of chloride. Certainly, excess applications of de-icing salt should be eliminated and better controls initiated to protect against slug loads to receiving waters during wet weather from salt storage. Large industrial sources may have to provide further treatment to remove chloride and TDS, and, to this extent, should be evaluated at a later date to determine if additional controls will be necessary.

Control of chloride discharges in Lake Michigan is one of the best methods available to limit the increase in TDS to protect the water quality of the international Great Lakes.

Mr. Chairman, this concludes my statement on the Chloride Report.

MR. MAYO: Any comments or questions, gentlemen?

MR. PURDY: Mr. Chairman, on the Chloride Report itself, on page 10 of the report, where it shows that the Morton Salt Company has 19,000 pounds per day, this should be recorded as prior to the operation of its injection system.

The company's August 1971 report showed an average chloride discharge of 57,300 pounds per day. The 19,000 pounds per day reported here is a load figure after completion of the injection system but before all of the operating problems of that injection system were corrected. So that its initial load was 57,000 pounds rather than 19,000.

And on page 11, for the Morton Salt Company, that 12,000 pound peak June 1971 loading should be 57,300 pounds per day.

Our operating report for Standard Lime and Refractory for July of 1972, 1,555,000 pounds per day.

Yesterday, when I gave our report, I indicated that the reduction at the end of 1973 would be an 80 percent reduction. We are not in disagreement on this figure, are we? You report 60 percent by June of 1973.

MR. SCHENZEL: I think it would be similar. If we multiplied 80 times 80, we are talking somewhere in the 60, 65 --

MR. PURDY: This is total tributary as well as point sources.

MR. SCHENZEL: Fine. I believe we are in agreement there.

I might point out, Mr. Purdy, that we were -- obviously communicating with your office in the development of these figures -- that since that report has been prepared there probably has been some updating on the figures based on the operation.

MR. PURDY: From the standpoint of the standard, when you are speaking of being substantially less restrictive than the existing water quality, you are not talking about the desirable monthly average shall not exceed 10 mg/1, you are talking about the permissible of 50.

MR. SCHENZEL: That is correct.

MR. MAYO: Mr. Miller.

MR. MILLER: Mr. Chairman, I think this is one of the items that we should make very clear. That -- while there are some terms used, such as recycling -- recycling is not really going to reduce the amount of chlorides that are discharged to Lake Michigan because, being an organic chemical, when the water or waste is being recycled -- once we reach equilibrium in the blowdown -- the amount we put in each day is going to be in the blowdown, and it will be discharged to the wastewater stream.

So that unless we come up with some method such as Michigan has talked about in deep well disposal to pull these out of the system entirely and put them in some other place besides in the wastewater stream, we are not going to be able to handle them and reduce the loads going to Lake Michigan other than to eliminate the source of the chloride entirely. In many instances, this will not be possible to do, and I think that many people lose sight of this fact. They use recycle as a possibility of reduction. But certainly the soluble salts, such as chlorides, are not going to be reduced in the discharge to a watercourse by a recycle system. And I think that we have this problem in some of the industries that are listed in the table for Indiana. Some of them are now on recycle systems and the amount of chloride that is reported there is the amount that occurs from the daily amount contributed to the system which must be removed to keep it in balance.

MR. BRYSON: Mr. Purdy, can I ask you to give us a brief description of the control program your companies are using in terms of the deep well injection?

MR. PURDY: Well, I think, in this case, we have to understand the industry, and the fact that the brines and the chlorides recently came from the ground. It is not a process waste that generated the chlorides within the process. And in this case the industry is taking a brine solution out of the ground; they are removing bromine and magnesium -- a form of hydroxide -- and then they have the remaining tail brines at rather high concentrations, that when properly separated within the plant, they can then be returned to the underground for measurement.

In the Manistee area, we have some particular problems in that there are a number of old holes in the ground, plugging really unknown, so that we have to be careful where we reinject those brines. But rather than a waste disposal process, we, in Michigan, are looking at this as a conservation of our natural resources. And those waste brines today are being returned to their original storage location for future use if at some time in the future a use is found for those remaining brines as a resource.

MR. MAYO: Is it practical to look forward, sometime in the reasonable future, to virtually 100 percent of that brine being returned to the ground?

MR. PURDY: I don't believe that we can look for 100 percent, in that in the process certain dilution water is added, and then you then have some high volume low chloride waste, and that this high volume cannot be returned to those ground formations without pressurizing the formations to the extent that we may have contamination of potable water supplies.

Certainly we are looking at the water concentration measures throughout the entire process, so that you can keep the tail brines in the concentrated form and can return the maximum volume to the underground formation.

In fact, we have requested the industries -- and they have cooperated in, say, joining together their brine supply, where one industry may take only the bromine out and not be interested in the other; that tail brine, then, is sent on to the next industry for removal of the magnesium. So that we only have one well rather than two wells.

MR. BRYSON: Are any additional controls planned once the companies are in compliance with the stipulations you have with them now? For example, Dow's runs out December 1, 1972. Are you looking for additional controls past that time?

MR. PURDY: Well, in view of, say, the total solids problem, not necessarily in Lake Michigan, but in the entire Great Lakes system -- Lake Erie, Lake Ontario -- I think it behooves us to attempt to get our finger on every source that we can and reduce it to the maximum extent possible.

When we reach our objective, why certainly I think that there will be continuing review of plant operations, evaluation of processes, and where possible additional reductions will be made.

MR. MAYO: Mr. Schenzel, in the very first sentence of the summary on page 14, the observation is made that: "The chloride level in Lake Michigan is not high enough at present to interfere with use of the water."

Harking back to a portion of Dr. Stoermer's commentary yesterday, he at least reflected that there appeared to have been some significant shift in algal species in the nearshore waters of Lake Michigan, perhaps as a consequence of increase in chloride level. And I am wondering whether any of the conferees -- perhaps Mr. Fetterolf would be willing to make some observations on that point.

MR. FETTEROLF: I would be glad to observe that

I see Dr. Powers out in the audience who might be able to make a comment on that.

I have no comment, Mr. Mayo.

MR. MAYO: I don't want to press the issue. I did want to at least recognize the fact that Dr. Stoermer did make that reference, and I am wondering if it is worth any discussion.

MR. FETTEROLF: The question is-- Stoermer referred to a shift in algal species when there was an increase in chloride levels accompanied by total dissolved solids increases -- whether this current level of 6 to 12 mg/l chloride is in that ballpark where you could look for stimulation of algal growth, or whether the observed concentrations in Europe were much greater.

DR. POWERS: I am Charles Powers from the National Eutrophication Research Program, EPA, Corvallis, Oregon.

Mr. Fetterolf, I think you have really called on the wrong man this time because I am not a very good algal physiologist.

Although I did take exception to some of the interpretations that Dr. Stoermer -- to some of his observations yesterday -- I do have a great deal of respect for him as an algal physiologist and taxonomist, and if he feels that the present chloride levels in the lake are sufficient to possibly bring about some percentages of increase, I think that this might possibly be correct.

We do know that as nutrient levels increase in lakes -- not only chlorides but nutrients such as nitrogen and phosphorus -- as they increase, we do know that different forms of algae will become dominant. We are not really sure why these changes occur, but as a lake becomes more eutrophic, we do know that diatoms do not necessarily disappear, but we know that the green and the blue-green algae will attempt to appear in greater numbers; and, at various times of the year, the blue-greens and the greens then become the dominant forms, whereas previously the diatoms have been dominant throughout the season.

We do know, however, that if one brings about changes in these nutrient concentrations, that the algal forms may change back again. I can think of one small lake on which we have carried out some experiments in which blue-green algae were very dominant. In fact, practically nothing else grew. And I have had fun finding here recently there is a precipitating cause of it. And as a result of aerating the pond we were able to shift the algae from blue-greens almost entirely to green algae.

I think that one should not feel that if the chlorides have indeed brought about a shift in algal species that it is necessarily an irreversible shift -- and I am kind of weaseling here, but I think that is about all I feel I am qualified to say.

MR. MAYO: Thank you.

Any other questions, gentlemen?

MR. McDONALD: Yes, Mr. Mayo.

Mr. Purdy, while those are going to be substantial reductions by 1973 of chlorides, just some very rapid calculations indicate that you still have an enormous poundage going into the lake in a relatively concentrated area in Michigan. It looks like -- after your program is completed -- you still have at the end of 1973 some roughly 300 million pounds going in per year into the lake.

I am wondering whether, in view of the fact that each of these companies is subject to the Refuse Act Permit Program, as it now stands, and any legislation that is currently pending in Congress regarding permits, which calls for, at first blush, the best practicable waste treatment control currently available -- whether this is, in your judgment, determination of the control program based on these stipulations -- whether this would constitute the best practicable control currently available.

MR. PURDY: Well, these companies will come under the agreement that we signed, on reviewing the Refuse Act Program discharger permit requirements. And, at this point in time, I can't say whether they will or will not come within the guidelines that your Agency has put out for this particular type of operation. As soon as they are out, we will be reviewing this in accordance with our agreement, and we will be proceeding to establish those requirements in accordance with our --

MR. McDONALD: Well, I'm not sure that these will be out in the immediate future, and in accordance with the agreement, if they are not out, we are going to have to operate under the best premise, I think, jointly, of determining maximum control of each of these companies.

MR. PURDY: Well, in accordance with our agreement, if those guidelines do not appear for that particular industry, we will be reviewing this process with your people so that we are in agreement that they have, in fact, established the best practical control procedure.

MR. McDONALD: Let me ask you if you can tell us what additional control techniques -- elimination techniques -- are available beyond disposal?

MR. PURDY: If I could answer that question, we wouldn't have requested it as a part of this process --

other than evaporation or reverse osmosis, I don't have really an answer.

MR. McDONALD: And these limits -- particularly for Standard Lime Refractory and Dow Chemical were set on what basis?

MR. PURDY: Looking at their process, grabbing onto every gallon of concentrated brine that we could and placing that back underground.

MR. McDONALD: And you are confident to squeeze every bit of it you can.

MR. PURDY: At the present time, yes.

MR. MAYO: Any other questions?

MR. SCHENZEL: Mr. Chairman, I had one additional question I would like to direct to the conferee from Illinois.

I would like to emphasize the Table A on page 5, and on Table A on page 5 request of the Illinois conferee: Is there any additional industrial dischargers that he feels should be placed on that list, or is the list now complete as you see it there?

MR. BLASER: It is complete as we see it there. "Domestic Waste Water" picks up several industrial sources, and "Pettibone Creek" picks up several, and they are all included there.

MR. SCHENZEL: Do you have any information on

U.S. Steel (South Works), for example, which may be discharging chloride that is finding its way into Lake Michigan?

MR. BLASER: To the best of our knowledge, it does not. They are well on their way to a closed-cycle system, and any discharges that they would have in the final analysis out of that would go to the Metropolitan Sanitary District.

MR. SCHENZEL: But they, in fact, could be discharging but you are saying in the long-term of things they will be eliminated?

MR. BLASER: That is right. They may be, but to the best of our knowledge are not.

MR. MAYO: Any other comments or questions, gentlemen?

MR. MILLER: Mr. Chairman, I do have one person who would like to comment, if we are down to public comments.

MR. MAYO: On chlorides?

MR. MILLER: On chlorides.

MR. MAYO: Yes. Do you want to introduce that individual?

MR. MILLER: Do you want me to call them?

I have Patricia O'Guin, of Valparaiso, who would like to speak on chlorides.

MR. MAYO: Would you please introduce yourself?

STATEMENT OF PATRICIA O'GUIN,
COMMITTEE TO PUBLICIZE CRISIS BIOLOGY,
INDIANA UNIVERSITY,
BLOOMINGTON, INDIANA

MISS O'GUIN: My name is Patricia O'Guin. I am representing the Committee to Publicize Crisis Biology from Indiana University at Bloomington, Indiana.

Just to reiterate what EPA recommended to this conference, the chloride report of the Environmental Protection Agency to this conference outlines the major reason for urging control of chloride discharges as being to help limit the buildup of Total Dissolved Solids (TDS) in Lake Michigan. According to EPA's report, the chloride level in Lake Michigan is increasing much faster than anticipated, and is rapidly becoming a potentially serious pollutant.

A major cultural source of chloride is that amount added to urban runoff through the use of highway de-icing salts. In data supplied by Wisconsin,the mean chloride concentration in a river as it passes through an urban area may double due to runoff containing salt.

Since chloride is not biologically degradable or removed from water by geological processes, it is much more logical to control the discharges through handling and use regulations rather than through water treatment. EPA's specific recommendations to the conference is stated in the following words:

"Control of chloride in urban runoff seems to be a matter of metering salt application to limit the amount applied to the minimum necessary to de-ice the streets. Salt stockpiles may be centralized to reduce the number of sites. The salt pile can be protected from rainwater and surface drainage. Retention basins can collect concentrated brine that does manage to leave the salt-loading areas."

In addition to these recommendations by EPA, I am urging this conference to recommend the study of viable alternatives to road de-icing salts for many reasons besides reducing the Total Dissolved Solids in Lake Michigan.

In brief, the use of de-icing salt, which has increased 1800 percent since 1940 according to the salt manufacturers, is polluting our groundwater and aquifers; killing trees, shrubs, and grasses; poisoning wildlife and endangering persons with certain health conditions; corroding cars, concrete, roads, and bridges; even producing a new form of air pollution. And, the researchers say, the effects of salt are cumulative -- a fact not realized before -

and in some cases are already irreversible.

Furthermore, the two main arguments for salting for snow and ice control, instead of sanding and plowing, can be shown to be false. According to the National Safety Council, accident statistics show that in 1969 only 2.4 percent of all fatal and 5 percent of all nonfatal accidents occur under snow and ice conditions. There is instead a direct correlation between dry pavement, increased speed of travel and high accident rate: 81.6 percent of all fatal and 75.6 percent of all nonfatal accidents occurred on dry pavement in 1969. Accidents under snow and ice conditions also tend to be fatal less often and are less expensive "fender benders" in terms of repair. The "bare pavement policy" should be replaced by a "public safety and mobility" policy of plowing, sanding, and driver education and information concerning winter driving conditions.

It is questionable whether the use of heavy salting and no sanding is economical. The town of Burlington, Massachusetts, which banned salt, saved considerable money by reverting to sanding and plowing only, in spite of increased spring cleanup costs. True costs to taxpayers must also include salt damage to cars, footwear, water supplies, trees, pets, and property values.

Perhaps the most significant accident statistics are those regarding the salt ban in Burlington in 1970. Although Burlington's population is 25,000, the city attracts thousands of cars to its industries and the Burlington Mall. Winn Street handles 22,000 cars daily in Burlington. In 1970, with unsalted roads, Burlington's nonfatal accident rate went down 4.7 percent, and its property damage accident rate decreased 2.1 percent over 1969's figures for salted roads. Newton, a nearby town with a traffic flow pattern equal to that of Burlington, experienced a 14.1 percent increase in nonfatal accidents, a 14 percent increase in property damage accidents. Fatalities increased from 2 to 7. All of this in spite of the fact that Newton continues to increase salting to 9,833 tons in 1970.

Groundwater pollution in Massachusetts has been steadily increasing at the same time salt use has increased. A chloride count of more than 250 ppm renders water unfit for human consumption according to the U.S. Department of Public Health. Because of salt pollution of wells from roadway de-icing salts, Burlington and many other cities in Massachusetts have had to close wells and seek water elsewhere.

Salt damage to trees is also cumulative, and both sodium and chloride are responsible for the rise in maple deaths in New England. Salt-injured trees show the same basic symptoms as drought-stricken trees: growth retardation, marginal leaf scorch, twig dieback, and eventually death.

In addition to salt damages in corrosion of cars, house siding, driveways, footwear, etc., there is evidence that salt corrodes concrete, bridges, and underground pipelines. Non-air-entrained concrete (less than 2 percent air) deteriorates rapidly when road salts are used and usually requires repairs after only two winters of use. Bridges are especially susceptible to damage in the winter because both the upper and lower sides are exposed, causing the bridge deck to freeze faster than ordinary pavement. Ice accumulates quicker and stays longer. As a result, more salt is needed to keep bridges clear, and more deterioration occurs. The structural steel embedded in the concrete on bridges is made vulnerable once the concrete cracks. Often a bridge has to be completely resurfaced after only 1 year.

Much of the previous data was taken from a study prepared by Mrs. Carolyn L. Whittle of Newtonville, Massachusetts, entitled "The Case Against the Use of Highway De-Icing Salts." Although the report was prepared specifically for the town of Newton, Massachusetts, it contains information that is applicable to any community.

In light of these facts, we urge the States in this conference recommend to their localities in the Lake

Michigan Basin that they study:

1. just exactly how the use of road salt is contributing to chloride loadings in their drainage systems;

2. what feasible means of controlling pollution from road salts are available,

3. especially including the alternatives to the use of de-icing road salts.

And that the States report on the results of studies for their localities on these three points as well as any steps the localities have taken to reduce chloride pollution from the use of de-icing salt to the next enforcement conference.

Thank you. (Applause)

MR. MAYO: Are there any questions, gentlemen?

MR. FRANGOS: Mr. Chairman.

MR. MAYO: Mr. Frangos.

MR. FRANGOS: Perhaps this might be an appropriate time to hear a public statement on the reports that we just heard this afternoon from Wisconsin.

At this time, is Mrs. Dahl here?

MR. MAYO: Would you introduce yourself, please?

STATEMENT OF MIRIAM G. DAHL,
WISCONSIN STATE DIVISION,
IZAAK WALTON LEAGUE OF AMERICA,
MILWAUKEE, WISCONSIN

MRS. DAHL: I am Miriam Dahl. I am from the Milwaukee area. I work in conservation with the Izaak Walton League and represent the Clean Water Committee in the State Division of Izaak Walton League.

I have asked to be heard today not because I want to speak directly to any one of these things but because I have what I would like to interject into this conference as a possible change of approach from all of the multiple problems which have been outlined in the 2 days I have spent listening.

May I say that, as are the doctors, we have been concerned with treating the results, not the causes. These things are not written in your statement, they are additions which I am making ad lib if you don't mind.

I would like to comment, as a preface, that we spend hours, use countless miles of legislative gauze and millions of dollars mopping up the pus from the running sores caused by our growing environment. It is time to look at the causes and to cut out the sources responsible for the multiple affront to the health of our vital resources. It is for that reason that I should -- and for your courtesy -- that I should like to give this thought to you for consideration. It is possible that from these thoughts will come some of the solutions which seem so far away at this point.

We ought to remember that waste disposal is not new; it has been with us as long as man has existed. Concern over these problems is not new either. The problem has just grown like Topsy with the expansion of our economy as the push for money led to waste of resources. The problem is not local. It is regional and international as well, leaving vast waterways full of debris of every description. Seeking for solutions to this problem is likewise not new.

One of the first books was written by a Mr. Dahlberg -- I believe his initials were C. L. -- it was written and published in 1920. It is worth reading; it is worth rereading. It doesn't hurt us to go back to the past to see where we want to point our trails into the future. 1920 is over a half century ago -- that is 50 years -- and a goodly part of my life.

Consistently ignoring the problem has not made it go away. Now we are faced with a survival problem if it continues. We insist on throwing mercury, PCB's, phosphates, chlorides, sugars, every conceivable type of waste, into our already overburdened waters. We threaten our own existence by this practice of poisoning ourselves.

Traditionally our solution has been dilution. Now we must think of new patterns of disposal and reuse of materials. The method of disposal of any nonusable resource can be on land as well as in the water. Reuse of phosphates, for example, would be a benefit on land. It is a hazard in the water. Chlorides can be replaced into the holes left by its removal -- and this was just said. And perhaps in line with that, at this point I might interject again that I am acquainted, as I think you are, with the movement in Cedar Rapids where the people there are faced with a pickle liquor from a metals industry upstream and with the discharges from the large Quaker Oats downstream. The Director of Public Works decided to build a 10-mile -- I think it was 10-mile -- pipe so that it connected the two, and the two were thereby canceled out or neutralized.

These things certainly could be done here. Extra chloride liquor from Michigan can be used with U.S. Steel. There are many kinds of combining various chemicals so that they can be neutralized. I am not a chemist. I wouldn't know all of the answers. But as a housewife who has had to make do for many years, I do know there are ways if we will find them. This is part of what I am asking you to do. Take a new look at this kind of thing. Recycling has come of age and we had better catch up with this idea before it runs away from us.

In brief, let us, beginning now, work on the concept of putting our wastes to work and using no -- I repeat, no -- waterways for disposal. This can be done if we will do it. It can work if we will try it. It is a revolutionary thought at this point, but all the tests applied result in a great plus for the method.

We hope that this meeting of conferees will accept this revolutionary method of disposal and work out the details with dispatch so that the change can occur within the next year to a recycling concept with disposal of wastes on land. Nothing going into our waterways, everything possible being used and used again, with final disposal of any wastes, which should be minimal, going into repositories or landfills where they can be used for some other purpose than their original use when the time comes for that.

This may call for drastic overhaul of present practices, laws regulating disposal, fines or alternatives for noncompliance for industrial, municipal and individual, but it will work if it is used. The alternative to this is further and more intense pollution of water until we have the problems of Europe, Asia and other international areas, or worse. This can be solved on a regional or national basis, but let us begin now.

Respectfully submitted, Miriam Dahl.

And, if I may, as an afterstatement, make this suggestion to you, it seems that we are completely neglecting one of our prime resources in this country --our youth.

I know that there were young men, young women in chemical research in their high school areas. One of them found a breakdown method, with the approval of his teacher, who didn't think that anything would come of it. But the young man found a breakdown method for the hard chain detergents. It never came to anything, but he found it.

Our youth are a veritable gold mine of ideas, of the verve, the wish to go ahead. Why don't you invite them into your conference? Why don't you send out into the schools and suggest that these people do something of this sort of work, or get the ideas from them? Why don't you have -- if you want to -- a contest? But use those young ideas. This is one of the ways in which you can move forward in a very much more rapid manner than is possible from just sitting and discussing this among one age group.

And I do thank you.

MR. MAYO: Any comments or questions?

We are at that point in the program where we had hoped to be along about noon, and that was to give us an opportunity to move into Executive Session to consider recommendations relative to the material that has been presented before the conferees up to this time.

As I mentioned this morning, our plan was to stop sometime between 4:00 and 5:00 o'clock. We are obliged to leave this room no later than 5:00, and I would like to have some sense of feeling from the conferees as to whether you would like to move into Executive Session between now and 5:00 in order to begin consideration of the recommendations, or whether you would prefer to recess now and move into Executive Session at 8:30 tomorrow morning.

Any comments, gentlemen?

MR. BLASER: I would just as soon we commence an Executive Session at 8:30 tomorrow morning, or earlier if you want, rather than go on at this time.

MR. FRANGOS: Well, I think I would agree with that, but I would like to get some feeling about the schedule for tomorrow. And surely we are going to be very crowded, and I am just wondering how available is this room in the late hours of the afternoon tomorrow?

MR. MAYO: It is available tomorrow and Friday.

MR. FRANGOS: I didn't ask about Friday, Mr. Mayo.

(Laughter)

MR. MAYO: I am being very concerned for Mrs. Hall and the consequences of running until almost 7:30 last night. I think we need to be alert to that as we proceed tomorrow.

One of the things we indicated doing earlier was to look at the corrections in the Status of Compliance Report material. I understand that Mr. Kee has that material available, and a review of it might be substantive to an Executive Session.

MR. BLASER: Mr. Chairman, Illinois promised to provide a revised list. If you recall yesterday, I described that we had measured compliance against the Illinois deadlines rather than Lake Michigan Enforcement Conference deadlines. I have the full revised list available for all conferees and anyone else who is interested.

(The documents above referred to follow in their entirety.)

MR. BLASER: In addition, there are additional materials in there including a copy of our thermal regulations. Further copies of thermal regulations will be at the back desk on the way out.

(The document above referred to is on file at U.S. EPA Headquarters, Washington, D. C., and Region V Office, Chicago, Illinois.)

COMPARISON OF DEADLINE DATES LAKE MICHIGAN ENFORCEMENT CONFERENCE VS. ILLINOIS WATER POLLUTION REGULATIONS

	Lake Michigan Enforcement Conference	Illinois Pollution Control Board
1. Upgrading of Municipal Waste Treatment	December 1972	a. July 1, 1972 Secondary Treatment Rule 404a (30/37) b. December 1974 High Quality (Rule 404d 4/5) North Chicago OK with (a) others over one year late. NSSD Litigation
2. 80% Phosphorous Reduction	December 1972	December 31, 1971 Rule 407 Standard 1.0 mg/1 Waukegan in compliance No. Cho., L. Forest, L.Bluff, Highland Pk. equipment installed but waiting for more. Will meet LMEC schedule.
3. Disinfection of Municipal effluents	May 1969	July 31, 1972 Rule 405 All existing and in compliance
4. Control of pollution from Combined Sewers	July 1977	December 31, 1975 Rule 602d-3 for Combined sewer overflows December 31, 1974 Rule 602d-1 for treatment plant bypasses All on schedule of LMEC
5. Upgrading of Industrial Waste Treatment	December 1972	December 31, 1973 Rule 408 Abbott Lab., U.S. Steel So. U.S. Steel, Waukegan and Chicago Hardware meet LMEC requirements. Fansteel Metallurgical Company behind one year.

September 19, 1972
CTB:dk

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
LAKE MICHIGAN ENFORCEMENT CONFERENCE
FOURTH SESSION SEPTEMBER 19, 1972

The importance which Illinois places on maintaining high water quality in Lake Michigan dates to the establishment of the Metropolitan Sanitary District of Greater Chicago in May of 1889 and is brought current by the attitude of our Pollution Control Board. In its opinion, which accompanies the Illinois Water Pollution Regulations adopted March 7, 1972, they establish the principle that Lake Michigan is a high quality water deserving of special protection. The Metropolitan Sanitary District of Greater Chicago also has spoken to the protection of Lake Michigan as witnessed in their Sewage and Waste Control Ordinance, Appendix A wherein they state "--- except that no sewage, industrial wastes or other wastes of any kind may be discharged into the waters of Lake Michigan". In keeping with this Illinois doctrine to protect Lake Michigan, the following action has been taken within the State of Illinois with respect to the recommendations of the conferees of the Lake Michigan Enforcement Conference originally convened March 1968.

1. Municipal Waste Treatment Within the Jurisdictional Boundaries of the Metropolitan Sanitary District of Greater Chicago, there is no discharge of municipal wastes to Lake Michigan. All of municipal waste in the district is diverted for treatment and discharge into the Illinois River Basin. The North Shore Sanitary District operates the only municipal waste water treatment facilities which discharge an average daily flow of 21.4 million gallons to Lake Michigan. These facilities are located at Waukegan, North Chicago, Lake Forest, Lake Bluff and Park Avenue, Ravine Drive, Cary Avenue in Highland Park.

The North Shore Sanitary District is currently engaged in a 116 million dollar project to upgrade these facilities and divert the effluent from the Lake Michigan Basin to the Des Plaines River water shed. These projects were originally scheduled for completion in July 1972 but due to extensive litigation completion is not expected until fall of 1974. In support of this project there has been a total of 51.7 million dollars of State and Federal Grant money offered to the North Shore Sanitary District. The Sanitary District reports over 40 million dollars in construction work under contract or already completed with an additional 21 million dollars of construction work in the plan and specification stages. Specifically for each plant -

A. Waukegan currently provides secondary treatment for only about two-thirds of the average daily sewage flow. The remaining one-third receives primary treatment and disinfection prior to discharge to the Lake. These facilities, while currently being upgraded, will not be complete by December 1972 and therefore is not considered in compliance with the recommendations of the conferees.

B. North Chicago - This facility provides secondary treatment and disinfection currently and is considered in cpmpliance.

C. Lake Forest - Is a primary treatment facility which will be discontinued with the flows diverted to the upgraded Clavey Road wastewater treatment facility. While construction on the pump station, force main is nearing completion connection cannot be made until the treatment facilities at Clavey Road are upgraded. Completion is scheduled for 1974, in the meantime this facility is considered not in compliance with the Enforcement Conference requirements.

D. Lake Bluff - This is a primary treatment facility also to be removed from service with wastewater being diverted to the Clavey Road interceptor and wastewater treatment system. Connection cannot be made until the Clavey Road facility is complete in 1974 and therefore the facility is not considered in compliance with the Conference requirements.

E. Park Avenue, Ravine Drive and Cary Avenue in Highland Park are three primary treatment facilities all of which will be discontinued with the flows diverted to the Clavey Road treatment facility in 1974. In the meantime primary treatment effluent continues to be discharged to Lake Michigan and is considered not in compliance with the Conference recommendations.

Summarizing approximately half of the twenty-one million gallons per day average flow tributary to the wastewater treatment facilities of the North Shore Sanitary District receives secondary treatment prior to discharge to Lake Michigan. The remaining half receives only primary treatment and disinfection. Upon completion of the North Shore Sanitary District projects there will be no known source of municipal waste being discharged to Lake Michigan within the jurisdictional boundaries of the State of Illinois.

2. Disinfection - All seven municipal wastewater treatment facilities provide effluent disinfection prior to discharge to Lake Michigan and are therefore considered in compliance with the Conference recommendation.

3. Phosphorous Reduction - The recommendation of the Conference was for 80% reduction by December 1972. Our Pollution Control Board in a matter identified as R 70-6 Phosphorous Water Standards established

effluent standards of 1.0 mg/l phosphorous as P for wastewater treatment facilities discharging to Lake Michigan. In response to these requirements, North Shore Sanitary District has installed phosphorous reduction facilities at its Waukegan facilities and is in compliance currently with the 1.0 mg/l standard. Equipment is currently being installed at the remaining six wastewater treatment facilities with operation scheduled prior to December 31, 1972. We therefore consider the wastewater treatment facilities in Illinois to be in compliance with the recommendations of the Enforcement Conference on the matter of phosphate reduction.

4. Combined Sewers - There are limited combined sewers within the North Shore Sanitary District facilities which overflow to Lake Michigan. At two sites Gillette Avenue and Water Street in Waukegan screening devices with disinfection facilities are under construction with completion anticipated prior to December 1974 and therefore in compliance with the recommendations of the conferees. Due to extraneous flows in this sanitary sewers tributary to the North Shore Sanitary District wastewater treatment facilities, there are overflows at the treatment plant sites. These overflows currently all receive disinfection. The North Shore Sanitary District construction project will include provisions for handling these extraneous flows. These facilities will be complete prior to the conferees deadline of December 1977 and are therefore in compliance with the Conference recommendations.

5. Industrial Wastes - Of the four industries discharging to Lake Michigan within Illinois, three are in compliance with the recommendations of the conferees to upgrade industrial wastewater

treatment facilities. The Illinois Environmental Protection Agency currently has an enforcement case pending against the fourth industry. The industries considered to be in compliance are U.S. Steel South Works, U.S. Steel Waukegan Works and Abbott Laboratories. The total average daily flow discharging to Lake Michigan from these three facilities is approximately 180 million gallons. The facility considered to be not in compliance is the Fansteel Metallurgical Corporation discharging an average daily flow of 2 million gallons. Therefore, more than ninety-eight and a half percent of the industrial wastes discharging to Lake Michigan is considered to be in compliance with the recommendations of the Enforcement Conference. It should be noted however, that the Illinois Water Pollution Regulations establish numerical values for many chemical constituents. These values are more stringent than the recommendation of the Conferees. Therefore, while the facilities might be in compliance with the recommendations of the Lake Michigan Enforcement Conference, it is conceivable that they are not in accord with current Illinois recommendations. It should be noted in the tabular Status of Compliance that Abbott Laboratory is considering tertiary facilities and diversion to the North Shore Sanitary District System; U. S. Steel Waukegan Works is currently engaged in engineering studies to upgrade their facilities; and U.S. Steel South Works is engaged in a project which will provide for recycling most of the industrial waters.

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GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

LAKE MICHIGAN

August 1, 1972

ILLINOIS DISTRICT OFFICE

DISCHARGER NAME & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	ESTIMATED TOTAL COST (MILLION $)	REQUIRED IMPLEMENTATION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	STATUS OF COMPLIANCE REQ'L REQUIREMENTS	COMMENTS AND/OR REASONS FOR DELAY
ILLINOIS MUNICIPALITIES							
NSSD - North Chicago Plant (Lake County)	Lake Michigan	4, 6		4 G 12-31-72	4 G =	1 Yes 2 Yes 3 Yes	North Chicago Plant: Separate Sewers, P.E. 20,000, Present treatment is secondary and chlorination 6-The North Chicago Plant is going to be a pre-treatment facility for the new Gurnee Plant. Completion of the Gurnee Plant is scheduled for February, 1974, and it will discharge into the Des Plaines River. Construction of the interceptor which will divert wastes from the North Chicago Plant to the Gurnee Plant was delayed due to litigation concerning bond issue and Gurnee Plant zoning difficulties. However, as of July 1, 1972, the interceptor is 12% complete. 4-State ordered North Chicago Plant to use alum in process for phosphorus removal by January 1, 1973. As of July 1, 1972 construction is 60% complete.
NSSD - Lake Forest Plant (Lake County)	Lake Michigan	3, 4		3 A 1967 B 1967 C 6-69 D 1969 E 1968 F 1-70 G 12-72 4 G 12-31-72	3 A = B = C = D = E = F = G O 4 G =	1 Yes 2 Yes	Lake Forest Plant: Separate Sewers, P.E. 8,000, present treatment is primary and chlorination. 3-Wastes from the Lake Forest Plant are to be diverted to the Clavey Road Plant which will be completed November, 1974. State advanced the completion date of Lake Forest secondary treatment or the equivalent to Jan. 1971. As of July 1, 1972 the pumping station is 99% complete. The interceptor has been completed. 4-Construction of facilities for phosphorus removal, required by 12-31-72, is on schedule.
NSSD - Lake Bluff (Lake County)	Lake Michigan	3, 4		3 A 1967 B 1967 C 12-69 D 6-70 E 1968 F 9-70 G 12-72 4 G 12-31-72	3 A - B = C = C = E = F = G 00 4 G =	1 Yes 2 Yes	Lake Bluff Plant: Separate Sewers, P.E. 1,400, Present treatment is primary and chlorination. 3-Wastes from Lake Bluff plant are to be diverted to Clavey Road Plant which will be completed November, 1974. State advanced the completion date of Lake Bluff secondary treatment or the equivalent to August, 1971. The Force main and sewer, section 1 (to Skokie sewer), is 92% complete as of July 1, 1972. Section 2 (Skokie to Middle Fork) is presently under design. 4-Construction of facilities for phosphorus removal, required by 12-31-72 is on schedule.

A - Retain engineers.
B - Submit preliminary engineering report.
C - Initiate detailed engineering plans and specs.
D - Submit detailed engineering specifications.
E - Arrange financing.
F - Initiate construction.
G - Complete construction and place in full-time operation.

[illegible] [illegible] Plans [illegible] Final Plans [illegible] Financing [illegible] Construction [illegible] Schedule [illegible] Schedule [illegible] than 1 year) (00) Behind Schedule (over 1 year) (*) Unilateral Extension Given by State (1) Sewage Plan Report (2) Disinfection (3) Secondary Treatment or Equivalent (4) Phosphorus or Nutrient Removal (5) New or Improved Trt. (6) Plant Expansion (7) Reduction, Removal or Neutralization of: Acid, (Cl) Chloride, (Cu) Copper, (Cn) Cyanide, (Fe) Iron, (M) Metals, [illegible] Nitrogen [illegible] Oxygen [illegible] (Ph) Phenol, [illegible] Solids, (TO) Threshold Odor, (8) Connect to Municipal System (9) Separation or Control of Combined Sewers (10) Storm Sewer Treatment [illegible] Clear water [illegible] (13) [illegible] Treatment (14) [illegible] [illegible] Evaluate Present Facilities [illegible] Reduction of All Critical Constituents (17) Advanced Waste Treatment

GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

LAKE MICHIGAN

August 1, 1972

ILLINOIS DISTRICT OFFICE

[illegible] & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	ESTIMATED TOTAL COST (MILLION $)	REQUIRED CONSTRUCTIONAL SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	STATUS OF COMPLIANCE ADD'L. REQUIREMENTS	[illegible]
ILLINOIS MUNICIPALITIES (Continued)							
NSSD - Park Avenue Plant Highland Park (Lake County)	Lake Michigan	3,4		3 A 1967 B 1967 C 9/69 D 10-70 E 1968 F 7/70 G12-72 4 G 12-31-72	3 A = B = C = D = E = F = G 0 4 G =	1 Yes 2 Yes	**Park Avenue Plant:** Separate Sewers, P.E 6 000, Present treatment is primary and chlorination. 3- Wastes from Park Avenue Plant are to be diverted to Clavey Road Plant which will be completed November, 1974. Construction of protection works for the interceptor sewer has started. 4- Construction of facilities for phosphorus removal, required by 12-31-72, is on schedule.
NSSD - Ravine Dr. Plant Highland Park (Lake County)	Lake Michigan	3,4		3 A 1967 B 1967 C 9-69 D 4-70 E 1968 F 7-70 G 12-72 4 G 12-31-72	3 A = B = C = D 10-70 E = F = G 0 4 G =	1 Yes 2 Yes	**Ravine Drive Plant:** Separate sewers, P.E 4,500, present treatment is primary and chlorination. 3- Wastes from Ravine Drive Plant are to be diverted to Clavey Road Plant which will be completed November, 1974. State advanced the completion of Ravine Drive secondary treatment or the equivalent to Sept.,1971. Construction of protection works for the interceptor sewer has started. 4- Construction of facilities for phosphorus removal, required by 12-31-72, is on schedule.
NSSD - Cary Avenue Plant Highland Park (Lake County)	Lake Michigan	3,4		3 A 1967 B 1967 C 9-69 D 4-70 E 1968 F 7-70 G 12-72 4 G 12-31-72	3 A = B = C = D 8-70 E = F 10-70 G 0 4 G =	1 Yes 2 Yes	**Cary Avenue Plant:** Separate Sewers, P.E. 6,500, present treatment is primary and chlorination. 3- Wastes from Cary Avenue Plant are to be diverted to Clavey Road Plant which will be completed November, 1974. State advanced completion date of Cary Avenue secondary treatment or the equivalent to October, 1971. Interceptor is 99% complete and the pumping station is 83% complete as of July 1, 1972. 4- Construction of facilities for phosphorus removal required by 12-31-72, is on schedule.

A - Retain engineers.
B - Submit preliminary engineering report.
C - Initiate detailed engineering plans and specs.
D - Submit detailed engineering specifications.
E - Arrange financing.
F - Initiate construction.
G - Complete construction and place in full-time operation.

KEY: [illegible]
(P) Preliminary Plans
(F) Final Plans
(Fi) Financing
(C) Construction

STATUS OF COMPLIANCE
(=) Ahead of Schedule
(0) On Schedule
[illegible] Behind Schedule (Less than 1 year)
(BB) Behind Schedule (Over 1 year)
(*) Unilateral Extension Given by State

REMEDIAL NEEDS
(1) Sample and/or Report
(2) Disinfection
(3) Secondary Treatment or Equivalent
(4) Phosphorus or Nutrient Removal
(5) New or Improved Trt.
(6) Plant Expansion
(7) Reduction, Removal or Neutralization of: Acid, (Cl) Chlorides, (Cu) Copper, (Cn) Cyanide, (Fe) Iron, (M) Metals, [illegible] (Oil) [illegible] (Ph) [illegible] (S) Solids, (10) Threshold Odor.
(8) [illegible]
(9) [illegible] Combined Sewers
(10) Storm Sewer Treatment
[illegible]
(13) Adequate Treatment
(14) Improve Operation
(15)* Evaluate [illegible]
[illegible]
(17) Advanced waste Treatment

GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

LAKE MICHIGAN

August 1, 1972

ILLINOIS DISTRICT OFFICE

[illegible]	RECEIVING WATERS	REMEDIAL NEEDS	ESTIMATED TOTAL COST (MILLION $)	REQUIRED CONSTRUCTION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	STATUS OF COMPLIANCE ADD'L. REQUIREMENTS	[illegible]
ILLINOIS MUNICIPALITIES (Continued)							
NSSD - Gillette Avenue Sewer Bypass Waukegan (Lake County)	Lake Michigan	9		9 A B C D E F G	9 A = B = C = D = E = 1968 F = G =		9 - The Gillette Avenue sewer bypass will be sealed upon completion of the Waukegan Plant improvement which is scheduled for September, 1973. Screening is installed. Illinois Pollution Control Regulations require stormwater control by Dec. 31, 1975.
NSSD - Water Street Sewer Bypass Waukegan (Lake County)	Lake Michigan	9		9 A B C D E F G	9 A = B = C = D = E = 1968 F = G =		9 - The Water Street Sewer Bypass will be sealed upon completion of Waukegan Plant improvement which is scheduled for Sept., 1973. IPCB ordered installation of screening devices by Sept., 1972. However, NSSD and A.G.'s office have not completed negotiations for required land and construction of screening facilities has not yet started. Chlorination to be provided. Illinois Pollution Control Regulacions require stormwater control by Dec. 31, 1975.
NSSD - Waukegan Plant Waukegan (Lake County)	Lake Michigan	4, 6		6 A 1967 B 1967 C 6-69 D 11-70 E 1968 F 3-71 G 12-72 4 G 12-31-72	6 A = B = C = D O E = 1968 F O G O 4 G 9-1-71	1 Yes 2 Yes 3 Yes 4 Yes	Waukegan Plant: Combined and separate sewers, P.E. 74,500. Present treatment is secondary and chlorinated. 6 - Though delayed by litigation, Waukegan Plant expansion is presently under construction with Sept., 1973 completion scheduled. Expansion includes full secondary treatment, plus overflow treatment. Advanced wastewater treatment is programmed and completion of plans is scheduled for August, 1972. Treatment plant effluent will be pumped to the DesPlaines River. 4 - Phosphorus removal is presently being provided through the use of $FECl_2$ to comply with Illinois Pollution Control Board recuirement of 1.0 mg/l as P.

A - Retain engineers.
B - Submit preliminary engineering report.
C - Initiate detailed engineering plans and specs.
D - Submit detailed engineering specifications.
E - Arrange financing.
F - Initiate construction.
G - Complete construction and place in full-time operation.

REMEDIAL NEEDS (1) [illegible] After Report (2) Disinfection (3) Secondary Treatment or Equivalent (4) Phosphorus or Nutrient Removal (5) New or Improved Trt. (6) Plant Expansion (7) Reduction, Removal or Neutralization of: Acid, (Cl) Chlorine, (Cu) Copper, (CN) Cyanide, (Fe) Iron, (M) Metals, [illegible] (10) Storm Sewer Treatment [illegible] (14) Improve Operation [illegible] (17) Advanced Waste Treatment

Page 1 of 2

GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

August 1, 1972

LAKE MICHIGAN

ILDO

DISCHARGER NAME & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	ESTIMATED TOTAL COST (MILLION $)	REQUIRED CONSTRUCTION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	STATUS OF COMPLIANCE ADD'L REQUIREMENTS	[illegible]
ILLINOIS INDUSTRIES				7	7		
U. S. Steel Corp. Waukegan Plant (Lake County)	Lake Michigan	7 (Fe, Acid, S)		A B C D E F G 12-72	A= B= C= D= E= F= G=	1 Yes	At Waukegan Department 1968 objectives to reduce discharge to Lake substantially met by the collecting and hauling of industrial waste. At present, however, some industrial wastes are treated by settling and acid reduction with discharge to Lake Michigan. Sanitary wastes are discharged to the NSSD Waukegan Plant. At North Chicago Department 1968 objectives to reduce discharge to Lake substantially met by the collecting and hauling of industrial wastes. Some industrial wastes are discharged through storm sewer to Lake Michigan. Sanitary wastes are discharged to NSSD North Chicago Plant. New IPCB Rules and Regulations require heavy metal reduction for both departments by 12/31/73.
				14,7	14,7		
Abbott Laboratories North Chicago (Lake County)	Lake Michigan	14,7 (BOD, S)		A B C D E F G12-72	A = B = C = D = E = F = G =	1 Yes 2 Yes 3 Yes	A permanent AWT facility was completed in 10/71. This facility does not handle all the flow. Combined waste stream and cooling water system in operation. Abbott is presently in compliance with SWB-7 requirements, however, new IPCB standards require additional tertiary removal by 12/31/74. Abbott is considering connection to the NSSD Gurnee plant which will be completed in February, 1974.

A - Retain engineers.
B - Submit preliminary engineering report.
C - Initiate detailed engineering plans and specifications.
D - Submit detailed engineering specifications.
E - Arrange financing.
F - Initiate consturction.
G - Complete construction and place in full-time operation.

KEY: CONSTRUCTION PHASE
(PP) Preliminary Plans
(FP) Final Plans
(FI) Financing
(CO) Construction

STATUS OF CONSTRUCTION
(+) Ahead of Schedule
(=) On Schedule
(-) Behind Schedule (Less than 1 year)
(BB) Behind Schedule (Over 1 year)
(*) Unilateral Extension Given by State

REMEDIAL NEEDS
(1) Sample &/or Report
(2) Disinfection
(3) Secondary Treatment or Equivalent
(4) Phosphorus or Nutrient Removal
(5) New or Improved Trt.
(6) Plant Expansion
(7) Reduction, Removal or Neutralization of: Acid, (Cl) Chloride, (Cu) Copper, (CN) Cyanide, (Fe) Iron, (M) Metals, (N) Nitrogen, Oil, (BOD) Oxygen Demand, (Ph) Phenol, (S) Solids, (TO) Threshold
(8) Connect to Municipal System
(9) Separation or Control of Combined Sewers
(10) Storm Sewer Treatment
(11) Exclude Clear water
(12) Sewers
(13) Adequate Treatment
(14) Improve Operation
(15) Evaluate Present Facilities
(16) Reduction of All Critical Constituents
(17) Advanced Waste Treatment

GREAT LAKES REGION

Pa: 2 of 2

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

LAKE MICHIGAN

August 1, 1972

Illinois District Office

[illegible] & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	ESTIMATED TOTAL COST (MILLION $)	REQUIRED CONSTRUCTION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	STATUS OF COMPLIANCE ADD'L. REQUIREMENTS	
ILLINOIS INDUSTRIES (Continued)							
Chicago Hardware and Foundry North Chicago (Lake County)	Lake Michigan						Industry closed.
Fansteel Metallurgical Corp. North Chicago (Lake County)	Pettibone Creek to Lake Michigan	7 (M)		A B C D E F G12-72	A = B = C = D E F G 0	1 Yes	Company operates a CN waste collection system which consists of collection by water, evaporation, and residue disposal by scavenging. Fansteel discharges to storm sewers not in conformance with water quality objectives. Illinois EPA enforcement case concerning these is currently in process. Company considering eventual discharge of wastes to NSSD.
U.S. Steel Corp. South Works Chicago (Cook County)	Lake Michigan and Calumet River	7 (Fe, S,Oil)		A B C D E F G 12-72	A = B = C = D = E = F = G =	1 Yes	This discharge was required to be in compliance with Interstate Standards by 12/68. Final plans and specifications are still being prepared. Court order issued January 18, 1971: 1. Elimination of all cyanide, phenols and ammonias from plant discharges by Oct. 31, 1972. MSDGC reports this phase on schedule. 2. Completion of facilities for recycling wastes from South Mills of this plant by Oct. 31, 1974. 3. Completing this recycling process for Northside Mills by April 30, 1975. 4. Completing recycling installations for the West Mills by Oct. 31, 1975.

A - Retain engineers.
B - Submit preliminary engineering report.
C - Initiate detailed engineering plans and specs.
D - Submit detailed engineering specifications.
E - Arrange financing.
F - Initiate construction.
G - Complete construction and place in full-time operation.

[illegible]: CONSTRUCTION PHASE
(P) Preliminary Plans
(F) Final Plans
(FI) Financing
(C) Construction

STATUS OF COMPLIANCE
(+) Ahead of Schedule
(=) On Schedule
(0) Behind Schedule (Less than 1 year)
(00) Behind Schedule (Over 1 year)
(*) Unilateral Extension Given by State

REMEDIAL NEEDS
(1) Sample &/or Report
(2) Disinfection
(3) Secondary Treatment or Equivalent
(4) Phosphorus or Nutrient Removal
(5) New or Improved Trt.
(6) Plant Expansion
(7) Reduction, Removal or Neutralization of: Acid, (Cl) Chloride, (Cu) Copper, (CN) Cyanide, (Fe) Iron, (M) Metals, (N) Nitrogen, Oil, (BOD) Oxygen Demand, (Ph) Phenol, (S) Solids, (TO) [illegible]
(8) [illegible] System
(9) Separation or Control of Combined Sewers
(10) Storm Sewer Treatment
(11) [illegible] Clear Water
(12) [illegible]
(13) [illegible] Treatment
(14) [illegible] Operation
(15) Evaluate Present Facilities
(16) Reduction of All [illegible] Constituents
(17) Advanced Waste Treatment

FOUR STATE LAKE MICHIGAN ENFORCEMENT CONFERENCE

MUNICIPALITIES	Intake Volume mgd	Distance from shore	Depth	Velocity fps	Discharge	Devices to minimize entrapment
Chicago Central	677	13,000 2,000	35 20	0.59 0.59	MSDGC * Backwash to Lk.M.*	1/2 inch mesh revolving screens
South	397	2.3 miles 1,600	32 24	0.19 0.19	MSDGC * Backwash to Lk.M.*	1 inch mesh
Evanston	25.76	2600-30" 5600-36" 5600-42" 1800-48"	14 24 24 12	11.0 11.0 11.0 11.0	MSDGC Backwash to Lk.M.*	Screens 3/4" openings
Glencoe	2.0	3324	21	0.33	MSDGC Backwash to Lk.M.*	Fine mesh screen
Highwood	0.5	2600	24		NSSD Backwash to Lk.M.*	1 inch openings in 4' dia.cap.
Highland Park	7.5	2000-16" 3500-20 1000-30	20 28 9	6 3.6 2.0	NSSD Backwash to Lk.M.*	3/8" openings in grate 7/16" openings in grate 6" openings in grate
Kenilworth	0.42	2100	24	0.89	MSDGC Backwash to Lk.M.*	1/2" openings in 12 foot long strainer 2 ft. dia.
Lake Bluff	0.75 mgd.	Purchased from Lake Forest				
Lake Forest	3.2	3000-24" Breakwater-16"	25	0.579	NSSD Backwash to Lk.M.*	2" openings in screen
Northbrook	2.0	2550	23		MSDGC Backwash to ditch*	6" mesh screens
North Chicago	4.4	6550	28			

MUNICIPALITIES	Volume mgd	Intake Distance from shore	Intake Depth	Intake Velocity fps	Discharge	Devices to minimize entrapment
Waukegan	9.3	6244	34	0.15	NSSD Backwash to Lk.M.*	None
Wilmette		4800	20		MSDGC Backwash to Lk.M.*	Slotted drums with 11" openings
Winnetka	19.5	1200	20	1.53	MSDGC Backwash to Lk.M.*	Screen over intake

* Plans in progress to divert or treat backwash water

IEPA
9/13/72
CT8:ep

FOUR STATE LAKE MICHIGAN ENFORCEMENT CONFERENCE

INDUSTRY	Volume mgd.	Intake Distance from shore	Intake Depth over intake	Intake velocity fps	Discharge	Devices to minimize extra equipment
Commonwealth Edison	854	Shoreline with 2000' intake canal	---	0.5 fps 2 fps at max. flow	To Lake Michigan	Fish net and floating boom
Johns Mansville Corp	2.5	1200	12	0.31 fps	Recirculated except 230 gpm to NSSD	None
U. S. Steel - Waukegan	3.5	6000	25	1.6 fpm 252 fpm incoming pipe	Lake Michigan	None

IEPA
5/13/72
GTB:ep

MR. MAYO: Thank you, Mr. Blaser.

Mr. Kee.

MR. KEE: Thank you, Mr. Chairman. I might indicate that Jim McDonald told me that I am going to keep doing this until I get it right, so I beg your indulgence as we go through it.

What I am going to do briefly is go over the summary tables that I presented yesterday that summarized the data on Status of Compliance. It has been updated by the presentations made by the individual State conferees yesterday and by our own Federal Activities Branch.

(The document above referred to follows in its entirety.)

Beginning with Table 1, which is the summary of the present status of phosphorus removal, for which there were only a few changes--these include the deletion of one municipality which was erroneously listed for Indiana; that is, Whiting, Indiana, and the addition of two new communities which Wisconsin added to their list, the Holland Sanitary District and Oconto Falls --this table is not changed other than for that fact.

In Table 2, the summary of industrial waste control, the only change is the change in the Illinois

LAKE MICHIGAN ENFORCEMENT CONFERENCE
REVISED TABLES
OF
STATUS OF COMPLIANCE REPORT

SEPTEMBER 20, 1972

TABLE I

LAKE MICHIGAN ENFORCEMENT CONFERENCE

SUMMARY OF PHOSPHORUS REMOVAL

STATE	SUBJECT TO REQUIREMENT		IN COMPLIANCE		ON SCHEDULE		BEHIND SCHEDULE	
	Sources	Served Population	Sources	Served Population	Sources	Served Population	Sources	Served Population
Illinois	7	114,000 100%	1	65,000 57%	6	49,000 43%	0	0 0%
Indiana	17	579,000 100%	4	75,470 6%	2	145,500	11	358,000 61%
Michigan	75	1,354,000 100%	6	216,312 16%	23	641,297 47%	46	496,214 37%
Wisconsin	45	1,839,000 100%	6	949,690 52%	5	53,630 3%	34	836,063 45%
Federal Installations	2	45,000	0	0 0%	0	0 0%	2	45,000 100%
BASIN TOTAL	146	3,932,000 100%	17	1,306,472 32%	36	889,427 24%	93	1,735,430 44%

Revised 9-20-72

TABLE 2

LAKE MICHIGAN ENFORCEMENT CONFERENCE

SUMMARY OF INDUSTRIAL WASTE CONTROL

STATE	SUBJECT TO REQUIREMENT	IN COMPLIANCE	ON SCHEDULE	BEHIND SCHEDULE
Illinois	5	3	0	2
Indiana	28	26	0	2
Michigan	5	4	1	0
Wisconsin	38	17	10	11
BASIN TOTAL	76 100%	50 76%	11 15%	15 19%

Revised 9-20-72

TABLE 3

LAKE MICHIGAN ENFORCEMENT CONFERENCE

INDUSTRIAL WASTE SOURCES BEHIND SCHEDULE

STATE	LESS THAN ONE YEAR BEHIND	MORE THAN ONE YEAR BEHIND
Illinois	Fansteel Metallurgical Corp. (North Chicago)	U.S. Steel (Waukegan)
Indiana	None	E.I. duPont (East Chicago) U.S. Steel (Gary)
Michigan	None	None
Wisconsin	Anaconda American Brass Co. (Kenosha) Badger Paper Mills (Peshtigo) Bergstrom Paper Co. (Neenah) Appleton Paper Co. (Combined Locks) Strange Paper Co. (Menasha) Kimberly Clark (Neenah) Scott Paper Co. (Oconto Falls) Scott Paper Co. (Marinette)	American Can Co. (Green Bay) Charmin Paper Products (Green Bay) Consolidated Paper (Appleton)

Revised 9-20-72

TABLE 4

LAKE MICHIGAN ENFORCEMENT CONFERENCE

MUNICIPALITIES IN VIOLATION OF MAY 1969 DISINFECTION DEADLINE

STATE	MUNICIPALITY
Illinois	None
Indiana	Ashley Goshen South Bend
Michigan	None
Wisconsin	None

Revised 9-20-72

TABLE 5

LAKE MICHIGAN ENFORCEMENT CONFERENCE

SUMMARY OF COMBINED SEWERS PROBLEM

STATE	SUBJECT TO REQUIREMENT		IN COMPLIANCE	
	Sources	Served Population	Sources	Served Population
Illinois	2	40,000	0	0
Indiana	15	749,000	0	0
Michigan	3	241,000	0	0
Wisconsin	14	859,000	1	2,000
BASIN TOTAL	34	1,889,000 100%	1	2,000 0.2%

Revised 9-20-72

Supplement to Status of Compliance
Report - September 20, 1972

TABLE 6

LAKE MICHIGAN ENFORCEMENT CONFERENCE

ANTICIPATED PHOSPHORUS REMOVAL DEADLINE DELINQUENTS

ILLINOIS

None

INDIANA

Angola
Gary
Goshen
Hobart
Mishawaka
South Bend--UC

MICHIGAN

Albion
Allegan
Andrews University--UC
Berrien Springs
Bronson
Charlotte
Delphi Twp.
Dowagiac
Eaton Rapids
Gladstone--UC
Grand Haven--UC
Grand Ledge
Grandville--UC
Hillsdale
Ionia
Iron Mountain
-Kingsford
Iron River
Lowell
Ludington--UC
Manistee
Manistique
Marshall
Mason
Menominee--UC
Michigan Reformatory
New Buffalo
Niles
Otsego
Paw Paw--UC
Plainwell
Portland--UC
South Haven--UC
Spring Lake--UC
Vicksburg
Wyoming--UC
Zeeland--UC

WISCONSIN

DePere
Kewaunee
Portage
Holland Sanitary District
Oconto Falls
Shawano Lake San. District

FEDERAL INSTALLATIONS

Fort Sheridan
Great Lakes Naval Training Center

NOTE: This table is based upon updated information presented at the Conference session on September 19, 1972. The list must be considered as tentative and subject to confirmation after the December 1972 deadline date.

UC--UNDER CONSTRUCTION

TABLE 7

LAKE MICHIGAN ENFORCEMENT CONFERENCE

ANTICIPATED PHOSPHORUS REMOVAL STATUS - DECEMBER 1972

STATE	SUBJECT TO REQUIREMENT		ANTICIPATED TO BE IN COMPLIANCE	
	Sources	Served Population	Sources	Served Population
Illinois	7	114,000 100%	7	114,000 100%
Indiana	17	579,000 100%	11	161,000 29%
Michigan	75	1,354,000 100%	39	1,066,000 89%
Wisconsin	45	1,840,000	39	1,800,000 98%
Federal Installations	2	45,000 100%	0	0 0%
BASIN TOTAL	146	3,932,000 100%	97	3,141,000 80%

NOTE: This table is based upon updated information presented at the Conference session on September 19, 1972. The list must be considered as tentative and subject to confirmation after the December 1972 deadline date.

dischargers: the addition of one to the "In Compliance" listing, and a corresponding subtraction of one from the "Behind Schedule" column.

MR. BLASER: Before you do that, may I interrupt? This still doesn't reflect it accurately.

The document we have handed to you -- it should show five subject requirements; four in compliance and one behind compliance. That is Fansteel which is behind schedule.

U.S. Steel at Waukegan should also show "In Compliance."

The material we handed out just now revised that.

MR. KEE: Okay. I think if we turn to Table 3, probably that would be more clearly indicated. What you are indicating is that the U.S. Steel (Waukegan Works) -- in the opinion of the State of Illinois -- and the South Works both presently meet the adequate treatment requirements established in 1968 by the conference.

MR. BLASER: By the conference, that is right; not necessarily by the PCB regulations for the State.

MR. McDONALD: Well, I think that distinction, Mr. Blaser, is very important, and that is they may meet the conference requirements, which were not quantified at the time as to the amount of reductions that had to take place;

neither were there effluent limitations. And what you are saying is that the minimal conference requirements, by your judgment --

MR. BLASER: Substantially so, yes.

MR. McDONALD: However, this does not mean that they meet the effluent limitations imposed upon them by the State of Illinois.

MR. BLASER: Right.

MR. McDONALD: Or the Refuse Act Permit Program; any limitation that may come out as a result of that.

MR. BLASER: Correct.

MR. KEE: There is an additional distinction, I think, to be made here, Mr. McDonald, and that is the fact that it is my understanding that the recycling program at the South Works has proceeded to the point that the north bank of their blast furnaces has gone to complete recycling, and that this is a substantive advancement. It is something that is quantifiable. I am not sure in determining, within my knowledge of the Waukegan Works, as to what exactly has been done at the Waukegan Works to bring this discharger into compliance with even the adequate treatment requirement.

Maybe Carl would like to speak to that.

MR. BLOMGREN: Mr. Kee, the Waukegan Works is currently now hauling 35,000 gallons a day of spent pickle liquor and other wastes to the Gary Works for deep well injection, and they have also been engaged for the last 4 or 5 years in extensive repiping internally to increase the percentage of waste pickle liquor that is being hauled away. It reduced their total pounds of iron that they discharge from something like 9,600 pounds a day back in the early sixties to a range of 100 pounds a day right now.

MR. KEE: Thank you, Carl.

On Table 4, the only change is the deletion of Clintonville from the list of those who do not meet the disinfection or who are not presently providing disinfection.

Table 5, Summary of Combined Sewers Problem, reflects the addition of 13 additional sources in the State of Indiana added to the existing 2 that had been listed. This raises the served population of affected sources considerably in the overall listing.

MR. PURDY: Mr. Kee.

MR. KEE: Yes, Mr. Purdy.

MR. PURDY: I reported yesterday the three for Michigan does not represent the complete list. There will be additions to that. I can't tell you how many.

MR. KEE: Okay. Thank you.

MR. BLASER: As far as Illinois is concerned, on the combined sewer, both sources have facilities scheduled for construction to meet the compliance date. They are not currently in compliance but they are on schedule.

MR. KEE: Thank you.

Presently we have no interim dates -- the conference doesn't -- so all we are faced with is determining"in compliance"as opposed to not being in compliance.

Are there any more comments on any of the tables up to this point?

I will move on to Table 6, where there is really a very significant change. In fact the table has been changed to reflect the information provided yesterday on anticipated phosphorus removal deadline delinquents as opposed to the earlier listing of those which were merely behind schedule. And I think I should point out the note on this table, that the table is based upon updated information presented yesterday, and that the list must be considered as tentative and subject to confirmation after the December 1972 deadline date, of course.

Then, Table 7 summarizes in statistical form the information from Table 6, and it gives a breakdown, including population, which is very important, because although some of these lists look long, many of them are smaller communities, and the impact, of course, is not as great if you have many smaller communities off schedule than if you had had a few larger communities. I think this is particularly shown in the case of Michigan where although 39 communities are indicated as likely to not meet the deadline, it is anticipated that a full 89 percent of the population served will be in communities that have phosphorus removal facilities on line by the deadline.

The basic control, coincidentally -- and I had no control over this -- turned out to be 80 percent of the population served will have facilities providing some level of phosphorus removal by the deadline. I think it is important to point out that that 80 percent is completely unrelated to the 80 percent of phosphorus removal requirement and it just happened to be that way coincidentally.

But the fact is that, at the present time, a significant proportion of the population is anticipated to have phosphorus removal on line by the deadline date, and that is a considerably different position than I gave yesterday when I got up here with information based strictly on the matter of whether or not the communities were behind schedule.

Of course, we have a lot of monitoring to do in the next 3 months to make sure that this anticipated level actually occurs and that will be one of the things that we will be looking forward to doing in the next 3 months.

MR. MAYO: Yesterday, you commented, Dave -- as I understood the commentary from the two representatives from the Great Lakes Naval Training Station and Fort Sheridan, I got the impression that interim phosphorus removal facilities might not be available in at least one of them before the end of the calendar year. Am I incorrect?

MR. KEE: I had the impression it was both of them and I think that was confirmed by Don Wallgren. But there is a meeting going on at Great Lakes with our technical representatives and representatives of both Fort Sheridan and the Great Lakes Naval Training Center to try to expedite this matter, and I hope that we will be able to see a change in that situation.

But I again have to reflect what we see right now, and that is that they indicated, I think, a June 1973 deadline, and we are going to try to get it turned around.

MR. MAYO: Thank you.

Any questions, gentlemen?

Before we actually recess, there has been a request to explain how the Executive Sessions are handled at the Enforcement Conference.

The Executive Sessions are such that they involve an interchange between the conferees to discuss the preparation of conclusions and recommendations that will flow from

F. Mayo

the conference. The exchange is exclusively between the conferees. The session will be in public. The public, however, will not be participating in the dialogue that takes place between the conferees.

With that, we will recess to get together for an Executive Session at 8:30 tomorrow morning in this room.

(Whereupon, the conference adjourned at 4:35 p.m.)

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